STRATUS CONSULTING

Natural Resource Damages Associated with Aesthetic and Ecosystem Injuries to Oklahoma's Illinois River System and Tenkiller Lake

Expert Report for State of Oklahoma, in Case No. 05-CV-0329-GKF-SAJ, State of Oklahoma v. Tyson Foods, et al. (In the United States District Court for the Northern District of Oklahoma)

Volume I

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David J. Chapman

Richard C. Bishop

W. Michael Hanemann

Barbara J. Kanninen

Jon A. Krosnick

Edward R. Morey

Roger Tourangeau

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Acronyms and Abbreviations

ACS	American Community Survey
CAPI	computer-assisted personal interviewing
CIS	Compact Information Systems
CV	contingent valuation
DOI	U.S. Department of the Interior
DUs	dwelling units
EPA	U.S. Environmental Protection Agency
FAQs	frequently asked questions
GIS	geographic information system
HUs	housing units
NOAA	National Oceanic and Atmospheric Administration
NRDA	natural resource damage assessment
OMB	Office of Management and Budget
PSUs	primary sampling units
USPS	U.S. Postal Service
WTA	willingness-to-accept
WTP	willingness-to-pay

Executive Summary

This document reports the results of a study commissioned by the State of Oklahoma to measure natural resource damages associated with excess phosphorus from poultry waste and other sources entering the Illinois River system and Tenkiller Lake (hereafter, the river and lake), based on injury studies developed by the State's injury experts. A team of internationally known experts in environmental economics, natural resource damage assessments, and survey methodology conducted the study over a more than two-year period. The study was undertaken within a framework of natural resource damage assessment (NRDA) as presented in the U.S. Department of the Interior's (DOI's) NRDA regulations.

Injuries to Oklahoma trust resources from this excess phosphorus have been documented in several reports by natural science experts. Natural resource damages are the monetary value placed on the changes resulting from injuries to Oklahoma trust resources of the river and lake.

In conducting the analysis reported here, the Team focused exclusively on damages from injuries that will result from past and current land applications of poultry waste and other sources. Furthermore, the Team considered only the aesthetic and ecosystem effects resulting from excess phosphorus. Negative aesthetic effects included algae-related reductions in water clarity and the presence of more algae on the bottom and along the edges of the river and lake than would otherwise have occurred. Excess phosphorus and algae have also affected, and will continue to affect, the fish and other elements of the ecosystem of the river and lake.

To estimate the monetary value of damages, the Team conducted a contingent valuation (CV) study. CV uses carefully crafted surveys to quantify economic values. Since 1963, there have been over 6,000 papers published on CV in the United States and other countries, a significant portion of which has been published in the peer reviewed economics literature. Statistical methods have been developed to estimate CV values, evaluate error bounds, and conduct sensitivity analyses. Based on the literature, guidance on conducting valid CV studies has been developed, including guidelines formulated by the NOAA Blue Ribbon Panel on Contingent Valuation. Results from CV studies have been used to inform many public decisions and to assess natural resource damages. CV is accepted in the DOI's regulations for conducting NRDAs.

The CV survey used in this study was designed and executed to meet the highest scientific standards, including the NOAA Panel's guidelines. A leading survey research firm used in-person interviews to collect the data. Analysis of the data, using well-accepted methods, tested and documented the validity of the results.

A conservative estimate of per household damages is $184.55. There are 1,352,878 households in the study area (63 Oklahoma counties included in the survey) based on the most recent estimates. Accordingly, a conservative estimate of the damages for the injuries to Oklahoma trust resources presented in the survey is $249,673,635 (1,352,878 multiplied by $184.55). The 95% confidence interval for the aggregate estimate is $224,198,942 to $275,148,328. This estimate of damages does not include additional categories of damages such as those resulting from injuries to groundwater or human health, or any damages for the years prior to this study.

1. Introduction

1.1 Introduction to the Research Team

This study was the work of a team of experts in economics and survey methodology (hereinafter referred to as "the Team"). Here, in alphabetical order, are the members:

- Richard C. Bishop, PhD, Professor Emeritus, Department of Agricultural and Applied Economics, University of Wisconsin, Madison
- David J. Chapman, MS, Principal, Stratus Consulting, Boulder, CO
- W. Michael Hanemann, PhD, Chancellor's Professor, Department of Agricultural and Resource Economics and Goldman School of Public Policy, University of California, Berkeley
- Barbara J. Kanninen, PhD, Arlington, VA
- Jon A. Krosnick, PhD, Frederic O. Glover Professor in Humanities and Social Sciences, Stanford University
- Edward R. Morey, PhD, Professor, Department of Economics, University of Colorado, Boulder
- Roger Tourangeau, PhD, Research Professor, Institute for Social Research, University of Michigan; and Research Professor, Joint Program in Survey Methodology, University of Maryland, College Park

1.2 Setting for the Study

The Illinois River begins in western Arkansas and flows west and south into Oklahoma, eventually emptying into the Arkansas River southeast of Tulsa. The Illinois River watershed includes about 1 million acres in the foothills of the Ozark Mountains. The area is predominantly rural, with roughly 90% of the land devoted to forests and pasturelands (Smith, 2008, p. 8).

The Illinois River is considered a valuable natural resource in Oklahoma. In 1970, Oklahoma passed a law designating the main stem of the Illinois River and two of its tributaries, Barren Fork Creek[1] and Flint Creek, as "Scenic Rivers" because these rivers possessed "such unique natural scenic beauty, water conservation, fish, wildlife, and outdoor recreational values" that they deserved special protection for the benefit of the people of Oklahoma (Oklahoma Scenic Rivers Act). Only three other rivers in the state have been designated as Oklahoma Scenic Rivers. There are no federally designated "wild and scenic" rivers in the State of Oklahoma.

Since the 1950s, the Illinois River watershed has grown into a major poultry-producing region that produces more than 100 million chickens and turkeys each year (Fisher, 2008). Poultry now dominates agriculture in the watershed, accounting for 85% of livestock sold in 2002 in terms of live weight (Smith, 2008, p. 12). Manure from poultry houses (sometimes referred to as "poultry waste") continues to be spread on land in the basin, mostly on land used for grazing (Fisher, 2008). Runoff and leachate from these lands has entered the Illinois River system and Tenkiller Lake for years and continues to do so today. This runoff and leachate contains excess phosphorus that contributes to increased growth of algae, to taste and odor problems in drinking water, and to human health threats from bacteria in both surface water and groundwater, from blue-green algae in the lake, and from by-products of treatment of algae-laden surface water for drinking. These problems have become more severe over the years and are expected to continue far into the future, even if all land application of poultry waste is banned now (Cooke and Welch, 2008a; Stevenson, 2008a).

1. An alternative spelling is Baron Fork Creek, a spelling that will be seen in quotations in this report. Barren is used here to match the spelling in the Oklahoma Scenic Rivers Act.

1.3 Charge to the Team

1.3.1 Overview of the charge

The State of Oklahoma has filed suit in federal court asking for, among other things, an injunction to stop all spreading of poultry waste on lands in the Illinois River watershed in both Oklahoma and Arkansas. Unfortunately, this injunction alone will not resolve the problems caused by excess phosphorus loading for many years. Large quantities of phosphorus from past spreading will remain in the soils in the area and will continue to wash into the Illinois River system (i.e., the Illinois River, its tributaries, and Tenkiller Lake) for the next 50 years and beyond.

The Team was commissioned to investigate natural resource damages in Oklahoma associated with the runoff and leachate of poultry waste into the Illinois River system and Tenkiller Lake, based on the state's injury studies, particularly Fisher (2008), Engel (2008a, 2008b, 2008c), Wells et al. (2008a, 2008b), Stevenson (2008a, 2008b, 2008c), and Cooke and Welch (2008a, 2008b). The Team was asked to conduct the investigation within the overall framework of a natural resource damage assessment (NRDA).

1.3.2 Approach to natural resource damages

For purposes of this report, "injuries" were defined as the deleterious chemical, physical and biological effects of excess phosphorus on water quality in the Illinois River system, including Tenkiller Lake. "Services" were the physical and biological functions performed by the natural resources and included the functions provided to humans. The overall level and quality of services that Oklahomans receive from the Illinois River system and Tenkiller Lake are linked to the quality of those resources. Injuries to natural resources result in lost services. "Natural resource damages" are the monetary value placed on the changes in services resulting from injuries to Oklahoma trust resources of the Illinois River system and Tenkiller Lake.

In conducting the analysis of damages reported here, the Team focused exclusively on damages from future injuries resulting from past and current land applications of poultry waste. Furthermore, the Team considered only the aesthetic and ecosystem effects resulting from excess phosphorus. Negative aesthetic effects included algae-related reductions in water clarity and the presence of more algae on the bottom and along the edges of the river and lake than would otherwise have occurred. The presence of excess algae has affected, and will continue to affect, the fish and other elements of the ecosystem of the river and lake. These effects of algae on the ecosystem will be discussed in more detail in Chapters 3 and 4. Table 1.1 lists the categories of damages estimated in this damage assessment report and indicates which categories were not included.

Table 1.1. Categories of damages included and not included in this study

Damage category	
Included	**Not included**
Damages for future aesthetics	Past damages
Damages for future ecosystem effects	Damages for groundwater injuries
	Damages for drinking water injuries
	Damages for human health effects
	Punitive damages

Past damages from aesthetic and ecosystem effects of algae are addressed in a separate report (Hanemann et al., 2009). Injuries to surface drinking water and groundwater were not addressed in this report or in the separate assessment of past damages.

1.3.3 The total valuation framework for damage assessment

This study was planned and executed using what is known as the *total valuation framework* (Freeman, 2003). Total values may include both use and nonuse values. As used in this study, *use values* are those values that are affected when members of the public personally use injured resources or would have used them in an uninjured state. For example, if excess algae in Tenkiller Lake reduces the aesthetics of the lake, or reduces catch of favored fish in the lake, enjoyment of the lake by anglers may decline, which would reduce the angler's use and/or enjoyment of the lake. *Nonuse values*[2] are values that people place on natural resources for reasons other than their personal use. For example, people may value natural resources of the Illinois River system and Tenkiller Lake in an uninjured state (e.g., without compromised aesthetics or ecosystem) because they want to bequeath them to future generations. This component of nonuse value is referred to as "bequest value." Or, they may place a value on simply knowing that a resource exists in an uninjured state, or for other reasons. This is referred to as "existence value." Nonuse values are also sometimes referred to as "passive use values."

Total value measures of natural resource damages are consistent with both economic theory and the definition of natural resource damages in the U.S. Department of the Interior (DOI) NRDA regulations at 43 C.F.R. 11.83 (C) (1):

2. For recent theoretical treatises on the topic, see Flores (2003) and Freeman (2003). Or see Anderson (2006), Field and Field (2006), Goodstein (2005), Hanley et al. (2006), and Tietenberg (2006).

> Compensable value is the amount of money required to compensate the public for the loss in services provided by the injured resources between the time of the discharge or release and the time the resources are fully returned to their baseline conditions, or until the resources are replaced and/or equivalent natural resources are acquired. The compensable value can include the economic value of lost services provided by the injured resources, including both public use and nonuse values such as existence and bequest values.

DOI's concept of compensable value formally incorporates the court opinion in *Ohio v. United States Department of the Interior,* 880 F.2d 432, 464 (D.C. Cir. 1989). "Option and existence values may represent 'passive' use, but they nonetheless reflect utility derived by humans from a resource, and thus prima facie, ought to be included in a damage assessment."

In addition, as stated in *Idaho v. Southern Refrigerated Transport, Inc.*, 1991 WL 22479 (D. Idaho 1991):

> Damages may also be recovered for the existence value of a natural resource, which one court defined as the value the members of the public place on the continuing existence of a natural resource, whether or not they will ever use the resource.

Total value is also included in economic analyses undertaken by federal and state agencies to assess the merits of proposed policies, regulations, and projects. Official guidelines for economic analyses recommend that total values be accounted for. For example, the Office of Management and Budget (OMB) sets standards that federal agencies must follow in preparing economic analyses. Guidelines for doing this are found in OMB Circular A-4 (U.S. OMB, 2003). Circular A-4 recommends that both use and nonuse values be included in economic analyses to the extent that it is possible to do so. Individual agencies such as the U.S. Environmental Protection Agency (EPA) make explicit provisions for inclusion of nonuse as well as use values in their economic analyses (U.S. EPA, 2000).

To summarize, the Team's use of the total valuation framework, as sanctioned by the courts and embodied in the DOI rules for damage assessments and federal guidelines for economic analyses, assured that *all* losses from harm to public resources were counted, to the extent practicable.

1.4 Approach to the Valuation of Injuries

1.4.1 Introduction to contingent valuation

To estimate monetary value of damages, the Team conducted a contingent valuation (CV) study. The CV study used a carefully crafted survey to elicit the monetary value on aesthetic and ecosystem injuries to Oklahoma trust natural resources in the Illinois River system and Tenkiller Lake, as determined by the state's injury experts.

The CV method has been widely applied to measure use and nonuse values around the world. Its use was first suggested by Bowen (1943) and Ciricacy-Wantrup (1947, 1952), who both conceived the idea of applying recent developments in survey research for the purpose of valuing government programs. Early on, the CV method was used to evaluate environmental issues, with the first known application to value hunting opportunities in the Maine woods (Davis, 1963). Other early studies included Hammack and Brown (1974), who valued waterfowl hunting in the western states; Cicchetti and Smith (1973, 1976), who evaluated the effects of congestion on the value of wilderness hiking; Darling (1973), who applied CV to amenities in urban parks; Randall et al. (1974), who applied CV to air quality in the Four Corners region of the United States; and Hanemann (1978), who applied CV to improvement in water quality at beaches. [3] Since 1963, there have been over 6,000 papers published on contingent valuation in the United States and other countries (Carson, Forthcoming). Results derived with this method have been used to develop and evaluate many public decisions[4] and to assess natural resource damages (Carson et al., 1994, 2003).

1.4.2 Thumbnail sketch of the survey

For this study, the Team designed a survey to be completed by a representative sample of adults living in Oklahoma. The survey was administered in the subjects' homes. Details of the survey are provided in Chapters 3 and 4, but a brief summary is included here to illustrate the use of CV and introduce the Team's actions in this study. The survey instrument itself is presented in Appendix A.

3. For more about the early history of CV, see Mitchell and Carson (1989, pp. 11-12). Many later studies are cited in Boyle (2003).

4. McCollum (2003) summarized many instances where nonmarket valuation studies have influenced federal and state policies and regulations. In the case of EPA, for example, he highlights the roles nonmarket valuation studies have played in analyses related to the Clean Air Act, the Clean Water Act, and the Resource Conservation and Recovery Act, among others. His exposition makes clear that CV is one of the most important tools used by economist to value natural resources. See also Morgenstern (1997) and Bishop and Welsh (1998).

Fundamentally, all CV surveys have three components in common. First, they describe the *problem*. Then, they describe a *solution*. And, finally, they ask a *valuation question* where respondents choose whether or not they are willing to pay the proposed cost to them for the solution to solve the problem.

The Problem: The survey narrative described the Illinois River system, including Tenkiller Lake, and explained how water quality, the ecosystem, and aesthetics have changed since around 1960. Then, it explained that these changes have come about because spreading of poultry waste and other human activities have introduced large amounts of phosphorus into the watershed, which in turn has resulted in excess algae. Next, participants were informed that the State of Oklahoma has asked for an injunction that would ban all future spreading of poultry waste in the basin. It was pointed out that even after a ban is in place, runoff and leachate of large amounts of phosphorus remaining on the land from past spreading would continue to affect the waterways. Therefore, compared with conditions around 1960, algae would continue to be excessive in the river and lake for many years (Engel, 2008a, 2008b, 2008c).

The Solution: The solution introduced in the survey was a program to treat land and waters in the Illinois River watershed with alum, a substance that bonds with phosphorus and makes it unavailable to plants, including algae. The survey noted that many states have successfully used a similar program to reduce algae.[5] The survey narrative explained that with alum treatments, it would take about 10 years for the river and 20 years for the lake to return to 1960 conditions, compared with 50 and 60 years, respectively, if alum was not applied. Hence, alum treatments would reduce the period over which the injuries would be present by 40 years for both the river and lake. Respondents were told that if alum treatments were implemented, the cost would be a one-time tax added to their state income tax bill next year.

The presentation of the alum treatment program allowed respondents to make a choice about a well-defined, realistic tradeoff. Either they could greatly reduce the injury and pay the tax for the alum treatments or accept the natural recovery without the alum treatment and use their money for other purposes. In Chapter 2 we discuss how tradeoffs of this type, which is the standard method used by economists, can be used to measure people's value for improvements to natural resources. While the State is not actually proposing this specific alum treatment program at this time, the choice was posed to the respondent as an actual choice. Posing choices in this manner is standard practice in CV surveys (Mitchell and Carson, 1989; Boyle, 2003).

The Valuation Question: The valuation question was posed as a referendum where respondents were asked to vote "for" or "against" the alum treatments. The one-time tax amount was varied

5. Discussion of alum treatments of lakes and citations to the literature on the topic can be found in Cooke et al. (2005).

randomly across respondents, as described in Chapter 3. The votes across the range of tax amounts then served as the basis for estimating the average value that households in Oklahoma place on a program to reduce the injury. As is common in these studies (Mitchell and Carson, 1989), households were used as the valuation unit.

1.4.3 Validity of the study results[6]

Good science requires an assessment of the validity of results. However, there is no single way to assess the validity of a study. Much research has been conducted to evaluate CV's validity, and federal agencies such as the U.S. OMB (2003) and U.S. EPA (2000) have developed guidelines on implementing CV studies. A national panel of experts, the National Oceanic and Atmospheric Administration (NOAA) Blue Ribbon Panel on Contingent Valuation (NOAA, 1993) (hereinafter the NOAA Panel) investigated this issue and also determined that, if conducted properly, CV studies can provide valid results.

The validity of a CV study begins with the development of a high quality questionnaire and the procedures to administer it to a sample of respondents. The survey developed for this investigation described a subset of the injuries identified by the State's natural scientists in clear, understandable ways; presented a realistic solution; and asked a valuation question that was both consistent with the economic theory and tractable for respondents. Additional questions to support data analyses and validity assessment were incorporated into the survey and carefully tested. The Team verified that the study conformed to applicable NOAA Panel guidance on validity assessment. Chapters 3, 4, and 5 of this report present details on survey design and administration. Chapter 6 presents statistical procedures and sensitivity analyses used to assess validity of the survey. Considering the evidence from all the applicable tests, the study met the standard for validity.

6. At several points in this report, we considered the degree to which the procedures we followed produced accurate results. In slightly more technical terms, we sought to assess the *validity* of our results. Even among social scientists, there is confusion about the meaning of the terms "reliability" and "validity." They are sometimes used as synonyms, but they have distinct meanings in most social sciences. "Reliability" refers to the consistency of the results produced by a measure applied to the same person. "Validity" refers to the degree to which a measurement tool accurately quantifies the underlying constructs. For example, the validity of an IQ test is whether or not it accurately measures a person's true intelligence. The reliability of the test would be whether the same test given to the same person multiple times gives the same result. We adhere to those definitions in this report.

1.5 Why Our Study Is an Appropriate Measure of Natural Resource Damages

The Team was assigned to estimate damages resulting from injuries to the aesthetic qualities and the ecosystem of the Illinois River system and Tenkiller Lake due to excessive phosphorus. Poultry waste spread on agricultural land in the past will continue to produce ongoing injuries and lost services into the future. Damages were calculated as the dollar measure of these losses, as measured by what individuals would be willing to pay for a program to accelerate reduction in future natural resource injuries to public trust resources in the Illinois River system and Tenkiller Lake. Specifically, the CV study developed a conservative measure of these damages, by estimating the mean willingness-to-pay (WTP) for a program that would return the flow of services from the Illinois River system and Tenkiller Lake to their 1960 condition 40 years sooner than without the program.

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2. Economic Value: Theory and Measurement

2.1 Introduction

In the first chapter of this report we outlined the regulatory and legal underpinning for the use of an economic measure of natural resource damages. In this chapter we discuss the specific economic measures employed in this study to estimate the natural resource damages from injuries to the Illinois River system and Tenkiller Lake from the release of excess phosphorus. The study employed a standard economic definition of value, and measured it using a standard technique. This chapter offers an explanation of that definition and describes that technique.

2.2 Background – Individuals Determine Value

Individuals have preferences for items. These items may be market goods and services, but they may also be items that are not traded in markets, including public goods such as public highways or services provided by the environment (e.g., air to breath, scenic views). Clean air and highway improvements cannot be purchased in a market; nevertheless, people may place a positive value on these items and be willing to pay something for them.

By definition, when people regard something as "good" they judge it as desirable, or perceive that it has positive value, while something they regard as "bad"[1] is viewed as undesirable and with the potential to negatively affect them. It follows that people would be willing to pay some amount to obtain a "good" thing, and would likewise be willing to pay some amount to avoid a "bad" thing. The citizens of Oklahoma are the judges of their own wellbeing; they are the ultimate authority for what they regard as a "good" or a "bad" and for how much they value that "good" or "bad." Ultimately, assignment of value is an individual decision.

2.2.1 What is economic value?

As stated in Chapter 1, the regulatory and legal foundations of natural resource damage assessments rely on economic value as a proper measure of damages. The questions then arise: What do economists mean when they use the term "value"; and how do economists measure that value? In this section, we focus on the first question; in the section that follows, we consider the second question.

The term "value" has a specific meaning in economics, and it is that meaning we employ throughout this report. Economics is inherently anthropocentric: it focuses on how and why people behave the way they do. Economic methods can be used to measure the value that people place on a good or service, but individual humans define that value. This anthropocentric approach justifies the application of the economic concept of value to measure damages in a natural resource damage framework. The anthropocentric approach holds that value is a human construct where all value derives, ultimately, from the preferences of individuals.

1. The preferences that people hold for items need not be positive preferences; they can also be negative preferences for things that people dislike. In that case the items are sometimes referred to as "bads" (rather than "goods"). These may include things like water pollution and unpleasant odors emanating from a factory.

2.2.2 Theory of value

The economic concept of value is defined in terms of tradeoffs. How much an individual is willing to give up of one thing to get another determines its value to that individual. When an economist states that, for some individual, item X has a value of 5 in terms of Y, it means no more, and no less, than that the individual would be willing to exchange one unit of X for 5 units of Y. The item that value is being measured against is called a "numeraire." The most common numeraire is money.[2] Accordingly, when economists state that, for some individual item X has a value of $50, they mean specifically that the individual would be willing to exchange X for $50. The concept of value is inherently individual – it depends on the preferences, outlook, and specific circumstances of the individual whose value is being measured.

The economic value of an item is not the same as its price. First, as noted already, the item may not have a market price, e.g., an improvement in air quality. Many things that affect human wellbeing do not have prices. Second, even if the item does have a price an individual may be willing to pay more than the price, and this extra WTP is part of its value to the person.

Methods to measure economic value are based on the following question: what is the maximum amount of money an individual would be willing to exchange for the item being valued if that exchange were feasible? The exchange may not in fact be feasible or practical. But, the economic value is what the person would exchange it for *if this were feasible*.

2.2.3 Nonuse value

Economic theory assumes that people behave purposively and consistently, and that they have preferences that motivate their actions and are revealed through their actions, whether in the market place, the home, or some other setting such as a survey or experiment. However, economics does not prescribe what people's preferences should be.

While economics does not prescribe what preferences people should have, it does provide a framework for *classifying* different types of preferences according to their economic implications. An important classification in the present context involves the economic distinction between use value and nonuse, or passive use, value. The distinction refers to two different ways in which an individual may care about the item in question. They may care for it in ways that affect their observable behavior, and/or in ways that do *not* affect their observable behavior. For example, a person may have a positive value for improving the cleanliness of a river at a recreation site. This value may influence the individual's behavior in an observable way (e.g., by resulting in more visits to the river when it is clean than when it is dirty). But, the preference

2. From now on in this chapter, we assume that the numeraire is money.

may also exist in ways that do not trigger a change in behavior that can be observed. For example, the number of trips to the river might not change, but overall enjoyment on each visit may be greater when the river is clean. Alternatively, someone may derive satisfaction just from knowing that the river is clean, whether they use it or not. Values associated with personal use are referred to as "use values;" values associated with motives not connected with personal use are referred to as "nonuse values" or "passive use values." As was pointed out in Chapter 1, *total value* includes both use and nonuse values.

2.3 Measures of Value

Economic value is framed in terms of an exchange of money for the item being valued. There are two alternative ways to frame an exchange: WTP and willingness-to-accept (WTA). WTP is the *maximum* amount those affected by natural resource injuries would be willing to pay to be rid of them. The WTA measure of damages is the *minimum* compensation those affected by the natural resource injuries would require to be as well off as they would have been had the injuries not occurred.

The WTP and WTA values associated with any particular change in the supply of a good or service are likely to be different. When they are not the same, the likely outcome is that the WTP value is less than the WTA value. Economic theory generally predicts that the minimum compensation required to forego an item is larger, not smaller, than the maximum amount someone would be willing to pay to get it.[3] The WTP measure, then, is an underestimate of the WTA measure.

To the extent that the WTP and WTA values differ, which is the appropriate measure to use? As noted by the NOAA Panel, "The conceptually correct measure of lost passive-use value for environmental damage that has already occurred is the minimum amount of compensation that each affected individual would be willing to accept" (NOAA, 1993). However, the NOAA Panel goes on to recommend: "The willingness to pay format should be used instead of the compensation required because the former is the conservative choice" (NOAA, 1993). In this study, we implemented a WTP format, recognizing that it is a conservative estimate

3. The theory underlying this issue is laid out in Hanemann (1991, 1999). This outcome occurs if preferences for the item display a diminishing marginal rate of substitution and the item in question is a normal good (i.e., the demand for it increases, rather than declines, with income). These conditions are likely to be satisfied for the environmental improvement being valued here.

2.4 Measurement

In general, there are two ways to measure value: the revealed preference approach and the stated preference approach. Both approaches involve tradeoffs made by individuals. The revealed preference approach relies on tradeoffs that people have been observed to make in markets and other venues, such as voting on tax referenda. The stated preference approach relies on tradeoffs that people make when confronted in a survey or in a constructed market.

Revealed preference for market goods provides information relating to the person's WTP for the item: the item must be worth at least as much to the person as the price for the item. This is not an exact measure of the WTP because WTP may exceed the price. But, by making some additional inferences, economists can derive a specific estimate of WTP from the observed pattern of demand behavior for market goods.

However, not all items people value are sold in markets. Moreover, nonuse values are not revealed through market behavior. The stated preference approach is used to value goods where no choices are observed to reveal individuals' preferences. With the stated preference approach, individuals disclose their preferences through their choices of tradeoffs presented in a survey or constructed market. As with the revealed preference approach, by making some additional inferences, economists can derive a specific estimate of WTP from the observed pattern of choices to the presented tradeoffs. With the stated preference approach, the value disclosed is their total value.

The most common stated preference approach is CV. With CV the outcome or situation to be valued is first described. This could be a market good (e.g., a new type of computer), a non-market good (e.g., a treatment to cure asthma), or a public good (e.g., a government program to improve education, or to clean up a nearby river). Once the item has been described, a valuation question is posed. Two types of questions are used.[4] The open-ended question format asks respondents, "What is the most you would be willing to pay for this?" With the closed-ended question format, respondents are first told "If this item is provided, it will cost you $Y," and then they are asked, "Would you buy this?" or "Would you vote for this?" depending on the context. In this latter approach, the monetary amount Y is varied across respondents in the sample. By themselves, the individual yes and no responses are not a measure of WTP. But, collectively, when interpreted using an economic model of response behavior, they reveal an estimate of the distribution of WTP from which a summary measure can be derived, such as the average WTP across the population sampled. The closed-ended approach is widely used by economists and was specifically endorsed by the NOAA Blue Ribbon Panel (NOAA, 1993). Therefore, the closed-ended approach was used for this assessment (Mitchell and Carson, 1989).

4. The questions given here are framed around the WTP measure of economic value.

2.4.1 Implications for our study

This study was designed to measure the total value placed by the public to more quickly reduce future natural resource injuries to Oklahoma trust resources in the Illinois River system and Tenkiller Lake as a result of excess phosphorus entering the system. The public's lost total value may include both lost use and nonuse values. A CV survey was used to estimate this value.

Given the goals of the study, the revealed preference method was not a viable alternative to CV in this case. The method cannot feasibly be used to estimate the lost total value due to excess phosphorus in the Illinois River system and Tenkiller Lake. The lost total value is the appropriate measure of damages in this case.

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3. Development of the Survey Instruments

3.1 Introduction

Development of the questionnaire took place between October 2006 and August 2008. During that period, the Team created and refined the *base instrument*, the questionnaire that was used to estimate damages (see Appendix A.1). A second questionnaire was also developed, the *scope instrument*, which described a smaller injury (see Appendix A.2) and was used to test whether respondents' judgments were sensitive to the size of the injury.

The goals of the base instrument development process were to build and refine a questionnaire that would:

- Be consistent with injuries as assessed by the natural scientists
- Be understandable to respondents
- Offer a realistic proposed solution to the injury problem
- Offer a plausible choice mechanism
- Include questions that would permit required data analysis
- Be perceived as neutral by respondents.

Several steps were carried out to fulfill these goals. Section 3.2 describes how the injury information was assembled. Throughout the process, focus groups were convened to test and refine the survey materials (Section 3.3). Draft versions of the questionnaires were tested in one-on-one interviews (Section 3.4). Drafts of both the base instrument and the scope instrument were pretested (Section 3.5) and two pilot tests were conducted (Section 3.6). Throughout all of these steps, the questionnaires were extensively revised to better achieve the study's goals. The scope instrument was developed as an integral part of this process (Section 3.7). And, the entire process was carried out in ways that satisfied the guidelines of the NOAA Panel (Section 3.8). The final section deals with another aspect of validity, consequentiality (i.e., whether respondents believe that their answers in a CV survey will actually affect what is done and how much they will pay).

3.2 Development of Injury Description

The Team worked closely with the state's natural scientists to ensure the injury descriptions developed for the two questionnaires were consistent with their findings. The Team also drew on expert reports written by Engel (2008a, 2008b, 2008c), Stevenson (2008a, 2008b, 2008c), Wells et al. (2008a, 2008b), Cooke and Welch (2008a, 2008b), and Fisher (2008).

3.3 Focus Groups

Table 3.1 lists specifics of focus group sessions conducted during the development process.

Table 3.1. Location, date, and number of attendees during the focus group stage of survey development

Location	Date conducted	Number of participants
Tulsa	October 26, 2006	20
Oklahoma City	March 15, 2007	17
Tulsa	April 5, 2007	22
Tulsa	April 18, 2007	18
Tulsa	April 19, 2007	20
Oklahoma City	May 9, 2007	19
Lawton	May 10, 2007	15
Oklahoma City	May 11, 2007	19
Tulsa	May 23, 2007	17
Tahlequah	May 24, 2007	20
Tulsa	November 6, 2007	20
Tulsa	November 7, 2007	20
Oklahoma City	December 12, 2007	15
Oklahoma City	December 13, 2007	18
Tulsa	May 19, 2008	30
Tulsa	May 20, 2008	28
Tulsa	June 2, 2008	32
Tulsa	June 3, 2008	46
Tulsa	July 17, 2008	22
Oklahoma City	July 18, 2008	23

Oklahoma firms that specialize in support services for focus groups recruited participants by telephone. A screener interview was conducted during the calls to achieve a balance in the socioeconomic characteristics of participants. Most of the group sessions were held in rooms equipped with a large table, chairs, easels/flip charts, and a separate observation room with a one-way mirror. In smaller communities that lacked focus group facilities, hotel meeting rooms were used, and closed-circuit video equipment allowed observers to monitor the proceedings.

Team members (Chapman and Bishop) moderated the focus groups, while groups of other team members observed all focus groups, either in person or by listening in by telephone. Early groups entailed relatively free flowing discussions to explore people's thinking about the issues and the language they would use to talk about them. Early drafts of the questionnaires were read aloud to the participants to simulate what would happen during face-to-face interviews.

Much of the focus group session centered on refining the details of the evolving questionnaires. The issues included:

- Describing the problem in terms that subjects could understand and identifying a solution that would be plausible to respondents. The plausibility of the solution that was ultimately proposed required that respondents understand a process by which future spreading of poultry waste would be banned, so some focus group time was also spent on this issue.

- Selection of photographs used to describe the injuries. Focus group participants were asked to describe their perceptions of photographs to assure they conveyed suitable information and were understandable to respondents.

- Concerns that were raised about potential unintended consequences of the alum treatments, which led to development of text to address this issue.

- Developing language to address the extent to which respondents thought that the poultry industry should pay for the cleanup, without suppressing revealed WTP by the respondents in ways that would not be indicative of their true WTP.

The focus group participants often mentioned that they had visited the Illinois River system and Tenkiller Lake, that their personal experience and conversations with others revealed that water quality there had deteriorated over the years, that they were reluctant to engage in wading, swimming, or boating, or have their children do so because of perceptions of low water quality, that poultry waste might be causing problems there, and that poultry farms in Oklahoma and Arkansas might be involved.

3.4 One-on-One Interviews

One-on-one interviews were conducted using cognitive interviewing techniques (Willis, 2004). Procedures for recruiting participants were the same as those used to recruit focus group participants. The purpose of these interviews was to evaluate how well the questionnaires would work in circumstances similar to those during the main study's face-to-face interview conducted in respondents' homes, to further probe people's understanding of the materials, to see how long the interviews would last, and to identify any issues requiring attention in the questionnaires.

Table 3.2 shows the location, date, and number of attendees at all of the one-on-one interviews.

Table 3.2. Location, date, and number of attendees during the cognitive interview stage of survey development

Location	Date conducted	Number of participants
Tulsa	December 19, 2007	10
Tulsa	January 9, 2008	14
Tulsa	January 10, 2008	12
Enid	January 24, 2008	18

The interviews were conducted in hotel rooms by members of the Team. The process involved reading the interview script and showing the participants the visual aids that would be used. The interviewer stopped from time to time to ask the participant what he or she was thinking, probe reactions to materials, and ask respondents to restate what was just communicated in his or her own words. Participants were asked to think aloud as they answered many of the survey questions.

3.5 Pretesting

The questionnaires were pretested in a hotel setting in Oklahoma City on four occasions. Participants were recruited for the hotel pretests in the same way as for the focus groups. Up to 50 people were recruited for each session. The sessions were held in large rooms with rows of tables and chairs facing the front, where a podium, projector, and projection screen were set up. By running four sessions per night with two concurrent sessions going at a time, up to 192 participants were interviewed in one evening.

The sessions were led by members of the Team and by Stratus Consulting employees. The leader read the questionnaire and used the projector to present the visual aids on the screen for all participants to see. Participants wrote their answers to questions on a form that was provided. Participants voted by writing on a paper ballot that listed the cost of the program, which varied across participants. Table 3.3 describes the locations, dates, and number of participants in the hotel pretests.

Table 3.3. Locations, dates, and numbers of attendees during the hotel pretests

Location	Date conducted	Number of participants
Oklahoma City	January 14, 2008	80
Oklahoma City	February 4, 2008	115
Oklahoma City	February 6, 2008	192
Oklahoma City	July 31, 2008	191

These initial pretests served multiple purposes. The hotel pretests provided the Team with a large sample size for assessing the base instrument In addition, the hotel pretests allowed preliminary comparisons between the draft versions of the base and scope instruments.

3.6 Stage 4. Pilot Testing

The focus groups, one-on-one interviews, and hotel pretests yielded base and scope instruments that could then be tested in the field under more typical survey conditions.

3.6.1 Introduction

Westat, the survey contractor, implemented two pilot field studies. The first pilot test took place in April 2008, and the second took place in July 2008. For both pilots, Westat used its normal procedures to recruit, train, and supervise the interviewers. For each pilot test, Westat selected 15 segments (individual census blocks or groups of nearby blocks) purposively, to include a combination of urban and rural areas and to avoid any areas that were selected for the main study. Purposive sampling is a form of non-probability sampling in which the sample is selected to meet some particular purpose or objective. In this case, the sample was selected to give an urban-rural mix and to avoid areas selected for the main study sample. Because of the short field period for the two pilots (15 and 17 days, respectively, for the first and second pilots), Westat did not conduct numerous callbacks to households. And although the interviewers initially randomly selected a household member to serve as the respondent, they were allowed to interview an alternative eligible household member if the randomly selected person was unavailable.

Table 3.4 describes basic features for each pilot study.

Table 3.4. Features of Pilot Studies I and II

Pilot	Field period	Number of completed main interviews
I	4/7/2008–4/23/2008	152
II	7/12/2008–7/30/2008	153

3.6.2 Pilot I

The first pilot test was done to assess the performance of the base instrument, including the computer-assisted personal interviewing (CAPI) programming, show cards, and maps under realistic field conditions. In addition, the first pilot yielded an initial indication of the quality of the address lists for Oklahoma. Of the 15 sample segments used, five were in rural areas and the remaining 10 were in urban areas. A systematic sample of 30 addresses was selected in each sample segment, with a target sample size of ten completed interviews per segment, to yield about 150 completed interviews in total.

Interviewer training for the field test was done in Tulsa between April 1 and April 4, 2008. Data collection began immediately afterwards and was completed by April 23. A total of 152 respondents completed the base interview during the pilot test. Interviewers completed screeners at each sample household, and the CAPI program was used to randomly select an eligible household member. Field supervisors completed "validation" interviews with a random subsample of the respondents. Validation interviews were done to confirm with the respondent that the interviewer actually carried out the main interview.

Debriefings with the interviewers revealed that the pilot instrument had worked well and the respondents paid attention to, and were interested in, the material provided. The interviewers offered some suggestions for improving the questionnaire, the functioning of the CAPI program, and the design of the show cards. Based on analysis of the data, the Team made a number of changes to the instrument.

The Team also evaluated the performance of the address lists purchased from Compact Information Systems. The ultimate source for most of the addresses on the purchased lists is the U.S. Postal Service's Delivery Sequence File. In ten of the segments, the list of addresses appeared to give accurate coverage of the residences (e.g., they included as many or more addresses as the 2000 census had found). As expected, in the rural areas, the address list did not appear to be useful as a sampling frame, so Westat ultimately carried out a field listing in rural areas. This consisted of field staff canvassing the sample area and listing all the housing units within the area. Typically, listers noted the addresses of the housing units, but, if there is no street address (as is common in rural areas), they wrote down a description of the unit instead.

3.6.3 Pilot II

The purpose of the second pilot was to provide a final test of the base instrument. As with the first pilot, the sample consisted of 15 purposively selected segments (individual or adjacent census blocks that had not been selected for the main survey sample). Six of the segments had to be field listed, and the remaining nine had acceptable addresses. Thirty addresses were selected (using systematic sampling) in each sample segment, with a target sample size of ten completed interviews per segment, again to yield about 150 total interviews.

Interviewer training for the field test was done in Oklahoma City, Oklahoma, from July 8 through July 11, 2008. Data collection began immediately afterwards and was completed by July 30. A total of 153 respondents completed the main interview in the second pilot. As in the first pilot, interviewers first attempted to complete a screening interview at each sample dwelling, and the CAPI application was used to randomly select an eligible member for the base interview. Interviewers were again permitted to interview another eligible household member if

the randomly chosen respondent was unavailable. Again, validation interviews were done by the supervisors with a random subsample of the respondents to the base interview.

The questionnaire worked well in the second pilot test. The interviewers indicated that respondents were interested in the questionnaire and paid attention to the material it presented.

The second pilot confirmed earlier information about the quality of the purchased address lists. In nine of the segments, the address list purchased from Compact Information Systems (CIS) proved to be suitable as a sampling frame for the selection of dwelling units; in the remainder, enumerators needed to carry out a field listing to serve as the frame for the next stage of sampling.

3.7 Development of the Scope Instrument

The scope instrument was a modification of the base instrument. The major difference was a change in the description of what the alum treatments would do. In the base instrument, without alum treatments, the river and lake would return to 1960 conditions in 50 and 60 years, respectively. With alum treatments, these time intervals were reduced to 10 and 20 years, respectively. The scope questionnaire said that alum treatments were not needed for the river, which would return to 1960 conditions in about 10 years on its own, simply as the result of the ban of future spreading of poultry waste. The scope instrument also said that alum treatments for the lake would be much less effective and would return it to 1960 conditions in about 50 years.

These changes in the scenario necessitated several other changes in the base instrument to create a scope instrument that was consistent with it. Except for necessary changes, the base and scope instruments were identical. The base instrument and the scope instrument are compared in detail in the next chapter. The base and scope instrument appear in Appendices A.1 and A.2.

3.8 Compliance with the NOAA Panel Guidelines

Under the Oil Pollution Act of 1990 (101 H.R.1465, P.L. 101-380), NOAA was charged with writing the rules for NRDAs relating to oil spills. To comply with this Act, NOAA evaluated whether CV is a reliable statistical method for measuring the economic value of public goods. To do so, NOAA created a Blue Ribbon Panel on Contingent Valuation (co-chaired by two Nobel laureates in economics, Kenneth Arrow and Robert Solow, and including other authorities on economics and survey methodology), which held hearings and issued a written report (NOAA, 1993). That report included "a fairly complete set of guidelines compliance with which would define an ideal CV survey" (p. 29).[1] The report said:

> A CV survey does not have to meet each of these guidelines fully in order to qualify as a source of reliable information to a damage assessment process. Many departures from the guidelines or even a single serious deviation would, however, suggest unreliability *prima facie* (p. 29).

The NOAA Panel outlined 25 guidelines, which are listed in Appendix H. Twenty-two of these guidelines were applicable to this study, and we met 21 of them. Here, we discuss how our study met the applicable guidelines and explain why the Team decided not to meet one of them. (A full discussion in on these issues can be found in Appendix H.)

3.8.1 Conservative design

The NOAA Panel (p. 32) stated[2]:

> Generally, when aspects of the survey design and the analysis of the responses are ambiguous, the option that tends to underestimate willingness to pay is preferred. A conservative design increases the reliability of the estimate by eliminating extreme responses that can enlarge estimated values wildly and implausibly.

Many steps were taken to implement this guideline:

- The scenario did not describe effects on human and animal health in detail. If the scenario had described such effects of blue-green algae in the Illinois River watershed and of

1. Page citations to the NOAA Panel's report refer to the version available via the Internet (http://www.darrp.noaa.gov/library/pdf/cvblue.pdf; accessed September 22, 2008).

2. In this quotation and throughout their report, the NOAA Panel used the term "reliability" to describe the possible accuracy of contingent valuation. As noted earlier, the report uses the term "validity" to describe to the same concept.

bacteria in runoff and leachate from pastures where poultry waste has been spread,[3] WTP may have been higher than we observed.

- The scenario did not describe taste and odor problems in drinking water that may be caused by large amounts of algae in water (see Cooke and Welch, 2008a, 2008b). If the scenario had mentioned this, WTP might have been higher than we observed.

- The scenario's stated times required for the river and lake to recover naturally after a ban on spreading new poultry waste is implemented (50 years and 60 years, respectively) were shorter than predicted by the natural scientists (see Engel, 2008a, 2008b, 2008c; Wells et al., 2008a, 2008b). If the scenario has described longer natural recovery times, WTP might have been higher than we observed.

- The photographs that were used were chosen to display relatively mild illustrations of water transformation, rather than more extreme versions. Presenting visual illustrations of more extreme instances of algae would have tended to yield higher WTP than we observed.

- The method used to calculate total WTP entailed making statistical assumptions that lowered the final damage estimate as compared to other reasonable assumptions that could have been made instead.

- Respondents were asked to vote on a one-time tax to pay for alum treatments instead of a proposal that would spread a series of smaller payments out over time. Economic theory suggests that the latter presentation may have yielded higher WTP estimates than we observed.

- Just before asking respondents to vote, the interviewer mentioned a series of reasons that could justify voting against the program and therefore made it clear to respondents that voting against would not be viewed as unreasonable.

- After respondents voted and answered a series of other questions, interviewers offered people who had voted for the program an opportunity to change their decisions and instead vote against the program.

- Before respondents voted, text in the questionnaires told them that the state of Oklahoma spends money on many other types of activities and resources and mentioned some of them explicitly (e.g., prisons, repairing roads, health care for children), thus highlighting other ways respondents might prefer for their tax dollars to be spent.

3. Cooke and Welch (2008a, 2008b) summarized the evidence for Tenkiller Lake.

- The scenario described many other rivers and lakes in Oklahoma, some of which are experiencing excess algae and others of which are not. Thus, the questionnaires identified other water bodies that could be viewed as substitutes for the Illinois River and Tenkiller Lake. The questionnaire also identified other water bodies where tax dollars could be spent on cleanup instead.

- The scenario mentioned undesirable effects of the alum treatment program.

- As discussed in Chapter 2, one could argue that the correct measure of damages in this case would be the amount of money Oklahomans would be willing to accept as compensation for the injury. Because WTP typically yields lower numbers than WTA measurements, this approach was conservative.

- Alum treatments were not viewed as completely effective at solving the problem by all respondents. This, too, yielded a conservative bias in measured WTP.

3.8.2 Elicitation format

The measurement of WTP was consistent with the NOAA Panel's advice. The Panel recognized that WTA is the appropriate measure, but recommended that: "The willingness to pay format should be used instead of the compensation required because the former is the conservative choice" (p. 32).

3.8.3 Interviewer effect

The NOAA Panel calls for pretests to assess whether the presence of an interviewer makes a difference on the answers (NOAA, 1993). Specifically, the Panel noted (page 31):

> It is possible that interviewers contribute to "social desirability" bias, since preserving the environment is widely viewed as something positive. In order to test this possibility, major CV studies should incorporate experiments that assess interviewer effects.

The Panel's concern was that voting in favor of the program is a socially desirable response and that respondents would be more likely to vote "for" when an interviewer administered the questions than when respondents completed the questions themselves. We evaluated this issue during the hotel pretests. The hotels pretests (described earlier in Section 3.5) used a form of self-administration; the respondents in the hotel pretests recorded their answers on an anonymous answer sheet rather than reporting them aloud to an interviewer. The team found little evidence that the proportion of respondents voting in favor of the program was systematically lower in the

hotel pretests than in other settings, such as the pilot tests, where interviewers administered the questions and recorded the respondents' answers.

These findings were in line with the results of a prior experiment done by Krosnick and his colleagues in 2002 (after the NOAA Panel issued its guidelines), who found no differences in WTP between respondents who indicated their vote by completing a ballot form and placing it in a ballot box and those who reported their answers to an interviewer (Krosnick et al., 2002). In addition, a recent review of the literature on socially desirable responding in surveys (Tourangeau and Yan, 2007) presented evidence that, although interviewer administration of the questions can increase socially desirable responding, such effects tend to occur with highly undesirable behaviors (like illicit drug use) rather than with attitudinal items (like the WTP question applied here).

3.8.4 Referendum format

Use of the referendum format to measure WTP was consistent with he NOAA Panel's advice: "The valuation question should be posed as a vote on a referendum" (p. 32).

3.8.5 Reminder of undamaged substitutes

The NOAA Panel stated (p. 33):

> Respondents must be reminded of substitute commodities, such as other comparable natural resources or the future state of the same natural resource. This reminder should be introduced forcefully and directly prior to the main valuation question to assure that respondents have the alternatives clearly in mind.[4]

From the beginning of the interview, respondents were told about substitutes and complements. The first map (Card B, Appendix A.1) and associated text told respondents that Oklahoma has many rivers and lakes. The second map (Card D) and associated text illustrated that Oklahoma has other officially designated Scenic Rivers and described where they are located. Card I showed various lakes and rivers in the state. As respondents looked at this map, the interviewer read:

4. It is worth noting in passing that at least two studies (Loomis et al., 1994; Neill, 1995) found no evidence that reminders of budget constraints and/or substitutes had any effect on respondents.

> Many of the other rivers and lakes in Oklahoma do not have excess algae. These are shown in blue on this map…. These include the other Scenic Rivers: Little Lee Creek, Lee Creek, and Upper Mountain Fork River ….
>
> Some rivers and lakes do have excess algae. These are shown in yellow on this map … The excess algae has caused changes in those places like the changes that have happened in the Illinois River and Tenkiller Lake. In nearby states, there are also some water bodies that have excess algae, and some water bodies that are clear.

Just before respondents were asked to vote, the interviewer read material and showed a summary card (Card N, Appendix A.1) that summarized some of the reasons why they might vote against the proposed alum treatments. The very first item on the list was: "Many rivers and lakes in Oklahoma do not have excess algae."

3.8.6 Open-ended follow-up questions

The NOAA Panel said (p. 34):

> Yes and no responses should be followed up by the open-ended question: "Why did you vote yes/no?" Answers should be carefully coded to show the types of responses, for example: (i) It is (or isn't) worth it; (ii) Don't know; or (iii) The oil companies should pay.

Immediately after respondents voted, they were asked open-ended questions about why they voted "against" or "for" the program or why they did not know how they wanted to vote. Answers to these questions were recorded and analyzed.

3.8.7 Cross tabulations

The NOAA Panel recommended (pp. 34-35):

> The survey should include a variety of other questions that help to interpret the responses to the primary valuation question. The final report should include summaries of WTP broken down by these categories. Among the items that would be helpful in interpreting the responses are:
>
> > Income
> >
> > Prior Knowledge of the Site

Prior Interest in the Site (Visitation Rates)

Attitudes Toward the Environment

Attitudes Toward Big Business

Distance to the Site

Understanding of the Task

Belief in the Scenarios

Ability/Willingness to Perform the Task

Cross tabulations to meet this guideline are presented in Appendix H.

3.8.8 Checking understanding and acceptance

The NOAA Panel stated (p. 35): "The above guidelines must be satisfied without making the instrument so complex that it poses tasks that are beyond the ability or interest level of many participants." One would infer from the heading "Checks on Understanding and Acceptance" that they also had in mind questions to probe how well the respondents understood the information presented to them and whether they accepted the scenario and other aspects of the survey.

A great deal of effort went into making the questionnaire understandable and acceptable, and several questions were included to gauge understanding. The questionnaire development process constantly involved assessing respondent understanding using focus groups, one-on-one interviews conducted by the Team, hotel pretests, and pilot surveys (see Chapter 3), which led to revisions of the questionnaire language to improve clarity and interest. The development process also consistently asked respondents whether they would like additional specific information in order to understand the materials being presented and make their voting decision. During the main study interviews, respondents were occasionally asked whether they would like any of the information repeated, to gauge their comprehension. Requests for repetition were exceedingly rare. After respondents voted, a series of questions were asked to discover what respondents were thinking when they voted. Answers to these questions consistently showed that a large share of respondents understood and accepted the scenario (see Section 6.4 for the results from these questions).

The NOAA Panel (pp. 27-28) concluded that a high standard of richness context "about the incident itself and about the respondent's circumstances and choices should be included in the

CV instrument" in order to have a survey that would yield reliable data and avoid problems of embedding and warm glow. We achieved this high standard.

3.8.9 Alternative expenditure possibilities

The NOAA Panel stated (pp. 35-36):

> "Respondents must be reminded that their willingness to pay for the environmental program in question would reduce their expenditures for private goods or other public goods. This reminder should be more than perfunctory, but less than overwhelming. The goal is to induce respondents to keep in mind other likely expenditures, including those on other environmental goods, when evaluating the main scenario."

Just before respondents voted, they read a card (Card N, Appendix A.1) summarizing some of the reasons why they might vote against the proposed alum treatments. Included were the following two reasons, which the interviewer also read aloud to the respondent:

> *If the state does increase your taxes, you might prefer that it spend the money on other environmental issues or on issues other than the environment.*
>
> *Or the tax increase might be more than your household can afford to pay.*

3.8.10 Scope test

The NOAA Panel stated, "if a CV survey suffered from [inadequate responsiveness to the scope of the environmental insult], we would judge its findings 'unreliable'." (NOAA, 1993, pp. 36, 62).

The Panel was referring to the expectation, based on economic theory, that WTP to achieve a larger environmental improvement should be larger than WTP to avoid a smaller one.

A scope test was an integral part of this study, and the data confirmed responsiveness to a scope manipulation.

3.8.11 No answer option

The NOAA Panel (p. 34) stated the following:

> A "no-answer" option should be explicitly allowed in addition to the "yes" and "no" vote options on the main valuation (referendum) question. Respondents who choose the "no-answer" option should be asked nondirectively to explain their choice. Answers should be carefully coded to show the types of responses, for example: (i) rough indifference between a yes and a no vote; (ii) inability to make a decision without more time or more information; (iii) preference for some other mechanism for making this decision; and (iv) bored by this survey and anxious to end it as quickly as possible.

As is clear from the quotation, the NOAA Panel's recommendation was based on the assumption that "no-answer" responses would occur because people were indifferent, were unable to make a decision, had a preference for some other mechanism, or were bored by the survey and wanted it to end.

Since the NOAA Panel issued its recommendation on this point, scholars have produced a substantial body of research that indicates that the NOAA Panel's assumptions about "no-answer" responses were only partly correct. In fact, a different approach to addressing the Panel's concerns is preferable for application in CV surveys.

This body of research indicates that, if a CV survey is designed very carefully to use language that is clearly understandable to respondents, and if the answer choices offered by questions are clearly understandable to respondents, then selecting an explicitly offered "no-answer" response option will very often be chosen by people who could instead offer a reliable and valid answer by selecting "vote for" or "vote against" if encouraged to do so (see the literature review by Carson et al., 1998; Krosnick et al., 2002). Therefore, offering a "no-answer" option would forego collecting valid votes. Because substantial effort was devoted to ensuring that the questionnaire was understandable to respondents and that respondents understood the choice, the questionnaire was designed to collect as many votes as possible by not offering a "no-answer" option. Respondents who volunteered that they did not know how they wanted to vote were encouraged to offer a substantive answer, and if they declined to do so again, interviewers recorded this declination.

To gauge the possibility that some respondents might have felt indifferent or unable to make a decision, the vote question was followed by a question asking respondents how certain they were of their vote choice. This is a more effective way of identifying uncertainty than is offering a "no-vote" option.

3.8.12 Summary of NOAA Panel guidelines

In this section, we have discussed how we implemented some of the most important of the NOAA Panel guidelines. A full listing of the guidelines and how we addressed them is presented in Appendix H. In designing and executing this study, we met all the guidelines except where they were not applicable to the research problem before us or where contributions to the literature published since the NOAA Panel finished its work indicated a better way to achieve the goals the Panel had in mind.

3.9 Consequentiality

Another design aspect of CV surveys that improves the validity of the results is consequentiality. As presented in Mitchell and Carson (1989, p.214), Rowe and Chestnut (1982) describe characteristics of a good CV survey as:

> "It must be informative; clearly understood; realistic by relying upon established patterns of behavior and legal institutions; have uniform application to all respondents; and, hopefully, leave the respondent with a feeling that the situation and his responses are not only credible but important."

"The closer a CV scenario comes to meeting this description, the more reliable the WTP amounts collected are likely to be." (Mitchell and Carson, 1989)

Carson and Grove (2007, p.183) have recently taken a hard theoretical look at what consequentiality involves. They summarize the answer in response to a rhetorical question:

> "Does a survey question need to meet certain conditions before it can be expected to produce useful information about an agent's preferences?"
>
> "This question is easy to address. First, the agent [respondent] answering a preference survey question must view their responses as potentially influencing the agency's actions. Second, the agent needs to care about what the outcomes of those actions might be."

Later in the article (p.188), Carson and Groves make it clear that, for consequentiality to hold, the respondent must assume that "the agency can actually compel payment for a good if it decides to provide it."

Our survey meets these requirements. Shortly after the possibility of alum treatments was introduced, the interviewers said:

> "After I tell you about the situation, I will ask you to vote on whether the state should or should not put alum on the land and in the water in order to return the river and lake to around 1960 conditions faster. Your vote will help state officials to decide whether to carry out the alum treatments."

Just before the vote question, interviewers told respondents:

> "If the people of Oklahoma want this to happen 40 years sooner, there will be an additional cost for the alum treatments. Oklahoma taxpayers will have to pay some of this cost …"

The interviewer later said:

> "We are interviewing people in Oklahoma to ask them to vote on whether the state should or should not put alum on the land and in the water. Your vote today will affect whether or not alum treatments are done."

The debriefing questions confirmed that most respondents believed the scenario (see Section 6.3 below). Hence, the validity of what we did was enhanced through the design of a consequential survey.

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4. Structure and Content of the Final Base and Scope Instruments

4.1 Introduction

This chapter presents the part-by-part wording of the base and scope questionnaires. All the quoted text presented in this chapter is the actual text used in the base questionnaire, except when the base text differs from the scope text. In those instances, the scope text is provided in italics below the base text. The complete base and scope instruments, including show cards and maps, are provided in Appendices A.1 and A.2.

The survey instrument has nine parts. The first six parts describe the injuries, their causes, how long it will take the river and lake to recover with and without the alum treatment program, how the program would work, and the voting exercise. Parts 7 through 9 include followup and debriefing questions about the survey material. The rest of this chapter provides an overview of basic interviewer training instructions and reviews each survey part in detail.

4.2 Survey Part 1. Introduction

The first part of the questionnaire introduced the topic of water in Oklahoma. It included introductory questions and ended with a description of the baseline conditions. Sections 4.2.1 and 4.2.2 of this chapter provide the context for asking the introductory questions and presenting the baseline conditions. The discussion below explains the content and purpose of each subpart of the questionnaire, and each explanation is followed by a display of the actual wording used in that subpart.

4.2.1 Introductory questions

The questionnaire contained two sets of introductory questions. Both sets of questions encouraged respondents to think about a wide range of policy issues. They also reminded respondents that cleaning up Oklahoma rivers and lakes is just one of many policy issues the state faces.

The first set of questions (Q1-Q6) asked how important six statewide issues were to respondents personally. The six issues were improving education in public schools, reducing water pollution in Oklahoma lakes and rivers, improving local libraries, reducing crime, helping farmers increase their incomes, and reducing state income taxes.[1] Reducing state income taxes was intended to remind respondents of the link between state programs and the amount of state taxes.[2] Improving education in public schools, improving local libraries, and reducing crime represent important statewide issues that can be the focus of state expenditures. Reducing water pollution in Oklahoma lakes and rivers was included to gauge respondent orientations toward this issue in general. Helping farmers increase their incomes was included to illuminate attitudes toward the farming industry.

1. The order in which the six items were asked was randomized, which complies with standard survey research practice.

2. Highlighting taxes helps address the NOAA Panel's recommendation to deflect "warm glow" motivations (NOAA, 1993).

Q1-Q6. To begin with, I'd like to ask you about some issues in Oklahoma. Some of them may be important to you personally. Others may not be important to you personally.

SHOW CARD A[3]

First, how important to you is (**READ X'd ITEM**)? Not important at all, slightly important, moderately important, very important, or extremely important?

The second set of introductory questions (Q7-Q12) asked respondents whether they thought the state spends too much or too little money on various environmental and non-environmental programs. These programs included (again presented in an order randomized for each respondent) building new state prisons, repairing roads, salaries for professors at state universities, healthcare for children, cleaning up pollution, and state parks.

Q7-Q12. The State of Oklahoma spends tax money on many programs for many different purposes. I'm going to read you a list of some of these programs. For each one, please tell me whether you think the State should spend more money on this, less money on it, or about what is being spent now.

First, (**ITEM**).

[**IF MORE/LESS]**: A lot more/less or a little more/less?

4.2.2 Description of baseline conditions

After Q12, respondents were told that the interviewer would give them information about a program and that the state wanted to hear their opinions about whether to start this new program, which would require taxpayer money.

These are just a few of the things the State of Oklahoma spends tax money on.

Sometimes, the State considers starting a new program. The State does not want to start a new program unless people are willing to pay for it. One way for the State to find out about this is to give people like you information about a program, so you can make up your own mind about it.

3. We used capital letters in the questionnaire to instruct interviewers not to read those words to the respondent. Instructions such as "(**SHOW CARD A**)" prompt the interviewer to display a card to the respondent.

To eliminate any perceived encouragement to endorse or reject the program, interviewers told respondents that different people have different views about the program.

> Some people think the program they are asked about is not needed. (**STOP**) Others think it is. We want to get the opinions of all kinds of people.

Following this statement, interviewers asked respondents:

> **Q13**. Before today, had you ever been interviewed like this to get your opinion about whether the State should or should not spend tax money for a particular purpose?[4]

Respondents then learned about the general topic of the survey.

> In the past, people have been asked about various types of programs. The particular program I am going to ask you about involves water in Oklahoma.

Next, interviewers told respondents what to expect for the remainder of the interview. Respondents learned they would be asked to vote "for" or "against" a particular program and that they would be asked to explain their vote. This advance notice was provided to encourage thoughtful consideration of the decision.

> I'll begin by telling you about a situation, and I will tell you how it came about. Then I'll ask you to vote for or against something the state could do to deal with the situation. I will also ask you to tell me why you feel the way you do. Your vote today will help the state decide what to do and may affect your taxes.

Interviewers were trained to read the material slowly so that all respondents could easily understand it. Interviewers explained this rationale to respondents and encouraged them to interrupt if they missed anything or if the material was read too quickly. Interviewers asked respondents to think carefully about each question.

> I'll read this information to you slowly to make it easy for you to understand it and think about it. If I go too fast or if you'd like me to repeat something, please just let me know, so I can slow down and read it again. And when I ask you questions later, it's important that you take as much time as you would like to

4. Answers to this question were recorded as "yes" or "no."

think carefully about each question and give me as accurate an answer as you can.[5] Is that ok?

Next, interviewers showed respondents a map of the main rivers and lakes in Oklahoma, highlighting the area around the Illinois River and Tenkiller Lake to help orient respondents to the study area.

STOP[6] **SHOW CARD B**

This map shows the main rivers and lakes in Oklahoma. The box (**POINT)**[7] shows an area of eastern Oklahoma that we will talk about.

Interviewers then showed respondents a map of the area around the Illinois River and Tenkiller Lake.

STOP **SHOW CARD C**[8]

This map shows this area in greater detail (**POINT TO INSET MAP**). Here is the Illinois River. (**POINT**)

Many small creeks flow into it. (**POINT TO SMALLER CREEKS**)

Two of the largest are Flint Creek (**POINT TO FLINT CREEK**) and Barren Fork Creek. (**POINT TO BARREN FORK CREEK**)

The area of interest for this study is the portion of the Illinois River watershed within Oklahoma. To describe the area to respondents, interviewers read the following text:

From now on, when I say the river (**POINT TO "THE RIVER"**), I will mean to include the Illinois River, Flint Creek, Barren Fork Creek, and the many smaller creeks flowing into them. (**POINT TO BIG CIRCLE LABELED "RIVER"**)

5. Inducing accountability at the start of the interview promotes optimal respondent effort (Tetlock, 1983).

6. The stop sign symbol instructed interviewers to pause before continuing.

7. This instruction reminded interviewers to point to the specific feature on the map.

8. This map showed the area around the Illinois River and Tenkiller Lake that respondents learned about. The map displayed a portion of Arkansas, which was printed in lighter colors than the portion in Oklahoma. This was done to draw attention to the Oklahoma portion, because the survey focused on the portion of the Illinois River watershed within Oklahoma, not in Arkansas.

Water from the river flows into Tenkiller Lake (**POINT**) and is stopped by the dam here. (**POINT TO DAM AND CIRCLE AROUND THE LAKE LABELED "LAKE"**)

Respondents next learned more about the geography and characteristics of the river and lake.

The part of the Illinois River (**POINT**) within Oklahoma above the lake is about 60 miles long.

Tenkiller Lake is about 28 miles long. Many miles of creeks flow into the river and lake.

Near the river and lake are the city of Tahlequah (**POINT**), smaller cities, farms, ranches, and private homes.

STOP UNTIL R IS FINISHED LOOKING AT CARD C

FLIP CARD TO NEXT, BLANK PAGE[9]

Interviewers then gave respondents some basic information about the river and lake and described the clarity of the water and the types of species living in the river and lake in the late 1950s and early 1960s. First, respondents learned about baseline conditions in the river.

In the late 1950s and early 1960s, the water in the river was clear most of the time, and it was easy to see rocks on the bottom.

Smallmouth bass and other fish had lived in the river for centuries. They ate small animals and insects living in the river.[10]

Then, interviewers told respondents about baseline conditions in the lake.

In the lake, the water was clear enough so you could see down about 10 feet.

Many largemouth bass, smallmouth bass, and other fish were there, and they also ate small animals, insects, and plants living in the water and on the bottom.[11]

9. This instruction was used when an interviewer was to flip to a blank page so the respondent would stay focused on the oral presentation rather than the visuals.

10. Stevenson (2008a, p. 44; 2008b; 2008c).

11. Cooke and Welch (2008a, pp. 1-2, 34, 43, 48, and Figure 9).

This narrative concluded with a statement about recreational use of the river and lake.

> Many people visited the area around the river and lake for sightseeing, fishing, canoeing, boating, and other activities.

Following the discussion about baseline conditions, respondents were asked several questions about visiting the Illinois River and Tenkiller Lake.

> **Q14**. Have you ever visited the Illinois River or the creeks flowing into it?
>
> **Q14A**. In what year did you first visit there? **(PROBE[12]: What year would you like me to type?)**
>
> **Q14B.** In what year was your most recent visit? **(PROBE: What year would you like me to type?)**
>
> **Q15**. Have you ever visited Tenkiller Lake?
>
> **Q15A**. In what year did you first visit there? **(PROBE: What year would you like me to type?)**
>
> **Q15B.** In what year was your most recent visit? **(PROBE: What year would you like me to type?)**

Answers to Q14 and Q15 were recorded "yes" and "no." If the respondent said "yes" to Q14, he/she was asked Q14A and Q14B; otherwise, the interviewer skipped to Q15. If the respondent said "yes" to Q15, he/she was asked Q15A and Q15B; otherwise, the interviewer skipped to Part 2. For questions 14A, 14B, 15A, and 15B, interviewers were instructed to record the exact word(s) used by respondents when answering the question.

12. For some questions, the Team asked interviewers to probe respondents if their answers were vague or did not address the question.

4.3 Survey Part 2. Description of the Injury

Part 2 of the survey started with interviewers telling respondents about the scenic river status of the river.

> In 1970, Oklahoma passed a law naming some rivers in the state "Scenic Rivers." The lawmakers said that these rivers possessed such unique natural scenic beauty, fish, wildlife, and outdoor recreational values that they deserve special protection for the benefit of the people of Oklahoma.

Interviewers showed respondents a map of all the rivers in Oklahoma that have been designated as scenic rivers.

> **STOP SHOW CARD D**
>
> This map shows all the rivers in Oklahoma that have been officially named Scenic Rivers.
>
> Flint Creek (**POINT TO FLINT CREEK ON CARD D**),
>
> the Illinois River (**POINT TO ILLINOIS RIVER ON CARD D**),
>
> and Barren Fork Creek (**POINT TO BARREN FORK CREEK ON CARD D**)
>
> were all named "scenic rivers" by the State.
>
> The lawmakers also named three other rivers as "scenic rivers:"
>
> Little Lee Creek, (**POINT**),
>
> Lee Creek (**POINT**),
>
> and Upper Mountain Fork River (**POINT**).
>
> **STOP UNTIL R IS FINISHED LOOKING AT CARD D**
>
> **FLIP CARD TO NEXT, BLANK PAGE**

Interviewers then asked respondents the following question:

> **Q16.** Before today, did you know that the Illinois River had been named a Scenic River?[13]

At this point, the interviewer began to tell the respondent how the river and lake have changed.

> During the years since around 1960, people have continued to visit the river and lake, but the river and lake have changed a lot over the last 50 years.

Interviewers used visual displays to help respondents think about how the river looked in around 1960 and how it looks now. Respondents learned about the river first.

> **SHOW R CARD E**
>
> Here are two pictures that show you how the river has changed.
>
> On the left is a picture showing what the river looks like when the water is clear and there is little algae. (**POINT TO PICTURE ON LEFT**). This is just meant to give you an idea of what the river usually looked like in around 1960.
>
> The picture on the right shows another part of the river recently with algae in it (**POINT TO PICTURE ON RIGHT**). This kind of algae grows along the edges and on the rocks at the bottom of the river. This amount of algae is most often seen between March and June. During the rest of the year there is usually a lot less. Algae can grow in water that stands still and in water that is flowing, as shown in the picture.[14]
>
> **UNTIL R IS FINISHED LOOKING AT CARD E**
>
> **SHOW R CARD F**
>
> Here are a couple of recent pictures of the river showing closer views of rocks on the bottom.
>
> (**POINT TO PICTURE ON LEFT**) The picture on the left shows a close view of the river's bottom with little algae.

13. Answers to Q16 were recorded "yes" and "no."

14. Stevenson (2008a, p. 21-22; 2008b).

(**POINT TO PICTURE ON RIGHT**) The picture on the right shows a place where algae has grown on the rocks at the bottom.

WAIT FOR R TO FINISH REVIEWING

FLIP CARD TO NEXT, BLANK PAGE

Algae also floats in the water and can make the water look murky. The water in the river used to be clear most of the time. Now, during summer, the water is sometimes murky because of algae.[15]

Algae on the bottom and in the water has changed the types of plants and animals that live in the river. There are now fewer of the smallmouth bass, other fish, and small plants than used to live in the river. In some places, the algae uses up most of the oxygen in the water. Low oxygen causes fish to grow more slowly. And in some places, some species have probably disappeared completely because of the algae.[16]

Respondents then learned how the lake has changed since around 1960. Interviewers used pictures to show how the lake has changed.

The lake has also changed. Although in around 1960, people could usually see down about 10 feet in the lake, now in the summer people can often see down less than 3 feet where the river comes in. As you move closer to the dam, there is less and less algae. Near the dam, people can still see down about 6 feet most of the time in the summer. In the winter, the water is clearer and people can usually see down about 10 feet throughout the lake.[17]

SHOW R CARD G

Here are some pictures that show how the lake has changed.

(**POINT TO PICTURE ON LEFT**) On the left is a recent picture to give you an idea of how the lake used to look most of the time in around 1960.

15. Stevenson (2008a, pp. 21-22).

16. Stevenson (2008a, pp. 27, 34-36, 38-41).

17. Cooke and Welch (2008a, Figure 9).

(**POINT TO PICTURE ON RIGHT**) The picture on the right shows how the lake sometimes looks these days, because the water is murky from algae.

UNTIL R IS FINISHED LOOKING AT CARD G

FLIP CARD TO NEXT, BLANK PAGE

In the shallow areas around the edge of the lake, the bottom is often covered with algae between spring and fall.[18]

In many parts of the lake where the oxygen and temperature were ideal for smallmouth bass and other types of fish people catch, there is now so little oxygen during the summer that these areas are no longer ideal for these fish. Under such conditions, smallmouth bass and the other types of fish grow slower and there are fewer of them.[19]

In large areas on the bottom of Tenkiller Lake, there are a lot fewer insects and small animals than are in lakes with less algae.[20]

Some other types of fish, such as largemouth bass, have increased in numbers and are growing more quickly.[21]

Following all the information about current conditions in the river and lake, interviewers asked respondents the following question:

Q17. Before today, had you heard anything about the changes in the river or lake that I just described?

Answers to Q17 were recorded “yes” and “no.” If respondents answered “yes,” they were asked this question:

Q17A. What had you heard?

18. Cooke and Welch (2008a, pp. 2, 29-33).

19. Cooke and Welch (2008a, pp. 3, 8-9, 37-41, and elsewhere).

20. Cooke and Welch (2008a, pp. 4, 44, 50).

21. Cooke and Welsh (2008a, pp. 40, 43).

If respondents said "yes" to either Q14 or Q15, interviewers asked the following question:

> **Q18.** Have you personally seen any of these changes in the river or lake, or have you not seen any of these changes?

Answers for Q18 were recorded as "yes, I have seen these changes" and "no, I have not seen them." If the respondent said "yes, I have seen these changes," he/she was asked this question:

> **Q18A.** What changes have you seen?

Interviewers then showed respondents a card summarizing the information presented previously in Part 2.

> STOP **SHOW CARD H**
>
> This card shows what I just told you.
>
> (**POINT TO ROW 1**) Around 1960, the water was usually clear, and now, during the summer, it is sometimes murky from algae.
>
> (**POINT TO ROW 2**) Around 1960, there was little algae on the bottom of the river and now, between March and June, there is more algae.
>
> (**POINT TO ROW 3**) Around 1960, there was little algae around the edges of the lake, and now, during the summer, there is more algae.
>
> (**POINT TO ROW 4**) Around 1960, species that live most easily in water with little algae were common and now they are less common.
>
> (**POINT TO ROW 5**) Around 1960, there was plenty of oxygen in the water. Now, in large parts of the river and lake, there is not enough oxygen, so some fish grow slower and there are fewer of them.
>
> STOP **UNTIL R IS FINISHED REVIEWING CARD H**
>
> **FLIP CARD TO NEXT, BLANK PAGE**

To adhere with the NOAA Panel's recommendations (NOAA, 1993), several different checks on respondent understanding and acceptance of the scenario were implemented throughout the questionnaire. One type of question, exemplified by Q19 below, gave the respondent the opportunity to ask that a part of the narrative be read to him/her again.

Q19. Is there anything I have told you about the river or lake that you would like me to repeat?

Answers were recorded "yes" or "no." When respondents answered "no," the interviewer skipped to Part 3. Respondents who said "yes," they would like something repeated, were asked the following question:

Q19A. What is that?

Interviewers recorded respondents' comments verbatim.

4.4 Survey Part 3. Causes of the Injury

Part 3 of the survey described the causes of injury to the river and lake. First, respondents learned who investigated the injury and then the causes of changes in the river and lake were described.

> Many scientists have studied why these changes have taken place in the Illinois River and Tenkiller Lake.
>
> Some of these scientists work for the State of Oklahoma; others work at Oklahoma universities, other universities, and research organizations.
>
> They agree that the river and lake have been changing gradually because of human activities.
>
> Some of the changes were caused by the increasing number of chickens and turkeys being grown in the area around the river and lake. About 140 million chickens and turkeys are now raised each year near the river in Oklahoma and Arkansas. This produces more than 300 thousand tons of what is called "poultry litter" each year. Poultry litter is chicken and turkey droppings mixed with wood shavings and other things put on the floors of poultry houses.[22]
>
> For many years, the people growing chickens and turkeys have collected the poultry litter and spread it on nearby land. Most of this land is used to grow grass for cattle and other animals. The litter contains phosphorus and nitrogen, which help grass to grow. But now, there is much more phosphorus than the grass can use. Rain washes some of this excess phosphorus into the river and lake. Once there, this phosphorus acts as a fertilizer to help more algae to grow on rocks and in the water.[23]
>
> Scientists have measured how much phosphorus comes into the river and lake from different sources. They have found that about 60% of the phosphorus in the river and lake is from chickens and turkeys. The other 40% comes from sewage treatment plants, fertilizers bought in stores, and other sources.[24]

22. Fisher (2008, pp. 19, 22-24, 34-35).

23. Fisher (2008, pp. 25-30).

24. Engel (2008a, p. 93).

> Phosphorus in the river and lake is what's causing more algae to grow, to coat rocks, and to make the water murky. This affects the fish, other animals, insects, and small plants in the ways I described earlier.

Part 3 concluded with a question about respondents' prior knowledge about the sources of the excess phosphorus.

> **Q20.** Before today, had you heard anything about why there is now more phosphorus in the river and lake than in around 1960?

Answers were recorded as "yes" or "no." If the respondent said "no," the interviewer skipped to Part 4. If the respondent said "yes," he/she was asked the following question:

> **Q20A.** What had you heard?

Interviewers recorded respondents' answers verbatim.

4.5 Survey Part 4. Recovery Program

In Part 4, respondents learned about the state's proposed actions to reduce phosphorus in the river and lake.

SHOW CARD I

Many of the other rivers and lakes in Oklahoma do not have excess algae. These are shown in blue on this map (**POINT TO BLUE AREAS**). These include the other Scenic Rivers: Little Lee Creek, Lee Creek, and Upper Mountain Fork River (**POINT TO OTHER SCENIC RIVERS**).

Some rivers and lakes do have excess algae. These are shown in yellow on this map (**POINT TO YELLOW AREAS**).[25] The excess algae has caused changes in those places like the changes that have happened in the Illinois River and Tenkiller Lake. In nearby states, there are also some water bodies that have excess algae, and some water bodies that are clear.

The excess algae in the rivers and lakes shown in yellow on the map is caused by phosphorus coming from various sources, and the state of Oklahoma is taking actions to reduce the amount of new phosphorus that goes into these rivers and lakes from these other sources.

For example, sewage treatment plants are being improved. And State environmental agencies will enforce new rules so that other fertilizers do less harm.

FLIP CARD TO NEXT, BLANK PAGE

The state is doing additional things to reduce phosphorus in the Illinois River, Flint Creek, and Barren Fork Creek, because Oklahoma law requires that these Scenic Rivers be kept clean. Tenkiller Lake is also a very popular place for people to visit and for recreation, so the State is putting extra effort into reducing phosphorus there as well.

The state has asked a federal court to stop all future spreading of poultry litter on land around the river and lake. The court is expected to make a decision about the

25. The Team generated the yellow areas on this map by using a geographic information system (GIS) layer provided by The Oklahoma Water Resources Board.

ban by the end of the year. The ban would immediately stop spreading in both Oklahoma and Arkansas.

At this point in the questionnaire, the base and scope instruments begin to diverge. For parts where the text is different, we show the base text first followed by "BASE:" and the scope text second in italics following *"SCOPE:"*

BASE:

The ban and the other things being done will greatly reduce the amount of new phosphorus put onto land and in the river and lake in the future, but a lot of phosphorus that was spread on the land in the past will remain there. For many years, it will continue to wash into the river and lake when it rains.

SCOPE:

The ban and the other things being done will greatly reduce the amount of new phosphorus put onto land and in the river and lake in the future. The excess phosphorus will quickly wash out of the river, but much of the phosphorus that's in the lake now will remain there.

Respondents then learned that alum treatment of the river and lake could reduce the excess phosphorus faster. Interviewers told respondents they would have to decide whether to vote "for" or "against" the alum treatment program.

BASE:

The purpose of this interview is to find out whether you think the State should or should not do something else as well. The excess phosphorus could be removed by putting alum on the land and in the water. I will tell you about what alum is and how it could be used to remove the excess phosphorus in a moment.

After I tell you about the situation, I will ask you to vote on whether the state should or should not put alum on the land and in the water in order to return the river and lake to around 1960 conditions faster. Your vote will help state officials to decide whether to carry out the alum treatments.

SCOPE:

The purpose of this interview is to find out whether you think the State should or should not do something else in the lake. The excess phosphorus in the lake could

be removed by putting alum in the water. I will tell you about what alum is and how it could be used to remove the excess phosphorus in the lake in a moment.

After I tell you about the situation, I will ask you to vote on whether the state should or should not put alum in the lake in order to return the lake to around 1960 conditions somewhat faster. Your vote will help state officials to decide whether to carry out the alum treatments.

The next question asked respondents about their prior knowledge about alum. Answers were recorded as "yes" or "no."

Q21. Before today, had you ever heard of alum?

Interviewers told respondents more about alum and its uses. Additionally, respondents learned that alum does not harm humans and that humans have been using alum for many years. The paragraphs below demonstrate how the information was presented.

Alum is a naturally occurring mineral. Deposits of it are in the ground in many places around the world.

Alum is safe for humans.

SHOW CARD J

Alum is in many products that people use, including food. For example, alum is used to keep pickles crisp, and you can buy alum powder at the grocery store for many uses, including cooking and making "play dough" for children.

WAIT UNTIL R IS FINISHED REVIEWING CARD J

FLIP CARD TO NEXT, BLANK PAGE

Also, water treatment plants in the U.S. and other countries have used alum to clean drinking water for more than 80 years.

An important component of the alum story is how alum neutralizes phosphorus in the river and lake. The following narrative was used to describe this process.

BASE:

When alum is put into river or lake water that contains phosphorus, the alum attaches to the phosphorus to form harmless particles that fall to the bottom and

blend into the dirt there. So if alum were put into the river and lake, the phosphorus there could no longer help algae to grow and there would then be a lot less algae in the water.

If alum is put on land, it attaches to phosphorus in the soil to form harmless particles. When these particles wash into rivers and lakes, the particles sink to the bottom and do not help algae to grow.

So to reduce algae in the river and lake, alum could be spread on the land and on the water.

SCOPE:

When alum is put into lake water that contains phosphorus, the alum attaches to the phosphorus to form harmless particles that fall to the bottom and blend into the dirt there. So if alum were put into the lake, the phosphorus there could no longer help algae to grow and there would then be a lot less algae in the water.

Alum treatments will not be needed for the river. The natural flow of water in the river will remove the excess phosphorus there. After the ban is in place, the river will naturally return to what it was like in around 1960 in 10 years. Phosphorus will remain in the lake much longer because the lake is large and the water moves through it very slowly.

Interviewers told respondents that the Army Corps of Engineers would work with the Oklahoma Department of Environmental Quality to spread alum.

BASE:

Here's how the alum treatments could be done.

The Army Corps of Engineers operates the lake, and they would work with the Oklahoma Department of Environmental Quality to spread the alum.

Crews of people would be hired and trained to use trucks to put alum on the land.

Specially designed boats would spread alum on the lake.

Alum would also remove phosphorus from river water flowing into Oklahoma from Arkansas. Dispensers would be put near the border to spread alum on the water when sensors find lots of phosphorus in it.

SCOPE:

Here's how the alum treatments would be done.

The Army Corps of Engineers operates the lake, and they would work with the Oklahoma Department of Environmental Quality to spread the alum.

Specially designed boats would spread alum on the lake.

The questionnaire described past experience with using alum and discussed its negative impacts.

BASE:

For more than 35 years, alum has been used successfully and safely to remove phosphorus and reduce algae in many states, such as Colorado, Texas, Missouri, South Dakota, Florida, Wisconsin, and Washington. Those states had some rivers and lakes with lots of algae like the Illinois River and Tenkiller Lake. Experiences in those states have convinced scientists that alum does not harm fish or other things living in water, and that alum treatments here in Oklahoma could safely return the river and lake to what they were like in around 1960.

Putting alum on the land and in the water would have some undesirable effects. The alum would be a white powder on the land surface until rains carry it down into the soil. After alum is put into the river and lake, it would make the water cloudy for a few hours until it settles to the bottom. And if anyone were to drink the lake water in the first hour, it might taste bitter.

Alum treatments would be needed for 5 years to remove all the excess phosphorus now on the land and in the water.

SCOPE:

For more than 35 years, alum has been used successfully and safely to remove phosphorus and reduce algae in lakes in many states, including Colorado, Texas, Missouri, South Dakota, Florida, Wisconsin, and Washington. Those states had some lakes with lots of algae like Tenkiller Lake. Experiences in those states have convinced scientists that alum does not harm fish or other things living in lakes, and that alum treatments here in Oklahoma could safely return the lake to what it was like in around 1960.

Putting alum in the lake would have some undesirable effects. After alum is put into the lake, it would make the water cloudy for a few hours until it settles to the

bottom. And if anyone were to drink the lake water in the first hour, it might taste bitter.

Alum treatments would be needed for 5 years to remove all the excess phosphorus in the lake.

Next, respondents were shown a card summarizing the main points in Part 4.

SHOW R CARD K[26]

This card summarizes what I just told you.

BASE:

(**POINT TO ROW 1**) A court-ordered ban would stop spreading of poultry litter near the river and lake in Oklahoma and Arkansas. This will occur even if alum treatments are not done.

(**POINT TO ROW 2**) Alum could be spread on land from trucks.

(**POINT TO ROW 3**) Alum could be spread on the lake from boats.

(**POINT TO ROW 4**) Alum could be sprayed in river water flowing into Oklahoma from Arkansas.

(**POINT TO ROW 5**) Alum treatments would need to be done for 5 years to remove all the excess phosphorus.

SCOPE:

(POINT TO ROW 1) *A court-ordered ban would stop spreading of poultry litter near the river and lake in Oklahoma and Arkansas. This will occur even if alum treatments are not done.*

(POINT TO ROW 2) *Alum could be spread on the lake from boats.*

(POINT TO ROW 3) *Alum treatments would need to be done for 5 years to remove all the excess phosphorus from the lake.*

UNTIL R IS FINISHED REVIEWING CARD K

26. Card K was different for the base and scope instruments. See Appendices A.1 and A.2.

FLIP CARD TO NEXT, BLANK PAGE

Next, respondents learned how effective the alum treatments would be at reducing phosphorus in the river and lake. Interviewers showed respondents a timeline to illustrate how soon the river and lake would return to around 1960 conditions with alum treatments.

If the federal court bans spreading of litter, alum treatments could begin soon after that.

SHOW CARD L (TIMELINE 1)

BASE:

As a result of alum treatments, the river would be back to what it was like in around 1960 (**POINT TO 1960**) about 10 years from now (**POINT TO 10 YEARS**). And the lake would be back to what it was like in around 1960 (**POINT TO 1960**) about 20 years from now (**POINT TO 20 YEARS**). Water in the river and lake would then be clear nearly all the time, and there would be little algae in the water and on the bottom. There would then be plenty of oxygen in the water. Species of fish, insects, small animals, and small plants that used to be common would slowly increase in numbers, replacing those that live in water with lots of algae. There would be fewer of some species, such as largemouth bass.

SCOPE:

*As a result of alum treatments, the lake would be back to what it was like in around 1960 (**POINT TO 1960**) about 50 years from now (**POINT TO 50 YEARS**). Water in the lake would then be clear nearly all the time, and there would be little algae in the water and on the bottom. There would then be plenty of oxygen in the water. Species of fish, insects, small animals, and small plants that used to be common would slowly increase in numbers, replacing those that live in water with lots of algae. There would be fewer of some species, such as largemouth bass.*

FLIP CARD TO NEXT, BLANK PAGE

Alum would only do this if much less new phosphorus is put on the land and in the water in the future. So no alum would be put out until after a court bans spreading of poultry litter.

Respondents were then asked about their prior knowledge about using alum to reduce algae. Answers to Q22 were recorded as "yes" or "no."

Q22. Before today, had you heard that alum could reduce algae in water?

If respondents said "yes," they were asked Q22A. Interviewers were instructed to record answers verbatim.

Q22A. What had you heard?

4.6 Survey Part 5.1. Natural Recovery

Part 5.1 described the recovery of the river and lake without the addition of alum treatments (e.g., natural recovery).

BASE:

The river and lake will go back to what they were like in around 1960 without alum, but it will take longer.

Scientists say that if spreading of poultry litter is banned, natural processes will allow the river and lake to gradually return to what they were like in around 1960, even with no alum treatments.

Rain would slowly wash the phosphorus into the river and lake for many years. Each year, a little less phosphorus would be washed into the river and lake.

Because the river flows into the lake, the phosphorus in the river would be washed into the lake and would be kept there by the dam. The phosphorus would sink to the bottom of the lake and would slowly be covered by dirt, which would eventually seal it off, so that it could not help algae to grow.

SCOPE:

Scientists say that if spreading of poultry litter is banned, natural processes will gradually return the lake to what it was like in around 1960, even with no alum treatments, but it will take somewhat longer.

The phosphorus remaining in the lake would sink to the bottom and would slowly be covered by dirt, which would eventually seal it off, so that it could not help algae to grow.

Interviewers showed respondents Timeline 2, which diagramed the difference between natural recovery and recovery using alum treatments.

STOP **SHOW CARD M (TIMELINE 2)**

BASE:

Without alum treatments, it will take about 50 years[27] (**POINT**) for the river to get back to what it was like in around 1960 (**POINT TO 1960**) instead of about 10 years (**POINT**). That is about 40 years longer. It will take the lake about 60 years[28] (**POINT**) to get back to what it was like in around 1960 (**POINT TO 1960**) instead of about 20 years (**POINT**). That is also about 40 years longer.

SCOPE:

*Without alum treatments, it will take the lake about 60 years (**POINT**) to get back to what it was like in around 1960 (**POINT TO 1960**) instead of about 50 years (**POINT**). That is about 10 years longer.*

UNTIL R IS FINISHED REVIEWING CARD M

FLIP CARD TO NEXT, BLANK PAGE

Part 5.1 concluded with another question to gauge respondent understanding of the scenario. Responses to this question were coded "yes" and "no."

Q23. Would you like me to repeat anything that I just told you?

If respondents answered, "no" to Q23, the interviewer skipped to Part 6. If respondents answered "yes" to Q23, they were asked Q23A. Interviewers recorded answers verbatim and then reread the requested portions of text.

Q23A What would you like me to repeat?

27. Engel (2008a, p. 1; 2008b, p. 11).

28. Cooke and Welch (2008a, p. 49; 2008b).

4.7 Survey Part 6. Description of Vote and the Voting Questions

Part 6 started by informing the respondent the poultry industry would have to pay the cost to safely dispose of any litter they produce from now on. Interviewers next told respondents that Oklahoma taxpayers would have to pay for the alum treatments. Interviewers told respondents that because some farms have gone out of business and because other Oklahomans contributed to the excess phosphorus the poultry industry would not pay for alum treatments .[29]

BASE:

If a court bans spreading of poultry litter, the industry will have to safely get rid of all the litter they produce from now on. The industry will have to pay for this, and the river and lake will naturally return to what they were like in around 1960. If the people of Oklahoma want this to happen 40 years sooner, there will be an additional cost for the alum treatments. Oklahoma taxpayers will have to pay some of this cost because many chicken and turkey farms have gone out of business over the years. In addition, many other Oklahomans contributed to the excess phosphorus through sewage and their use of fertilizer.

We are interviewing people in Oklahoma to ask them to vote on whether the state should or should not put alum on the land and in the water. Your vote today will affect whether or not alum treatments are done.

SCOPE:

If a court bans spreading of poultry litter, the industry will have to safely get rid of all the litter they produce from now on. The industry will have to pay for this. The river will naturally return to what it was like in around 1960 in 10 years, and the lake will naturally return to what it was like in around 1960 in 60 years. If the people of Oklahoma want the lake to return to what it was like in around 1960 in 50 years rather than 60 years, there will be an additional cost for the alum treatments. Oklahoma taxpayers will have to pay some of this cost because many chicken and turkey farms have gone out of business over the years. In addition, many other Oklahomans contributed to the excess phosphorus in the lake through sewage and their use of fertilizer.

29. The NOAA Panel recommended that the survey be designed to deflect the “dislike of big business” (NOAA, 1993).

We are interviewing people in Oklahoma to ask them to vote on whether the state should or should not put alum in the lake. Your vote today will affect whether or not alum treatments are done.

Next, respondents learned about the payment vehicle: the Oklahoma state income tax. Oklahomans would pay a one-time tax, which would be in addition to what the respondent already paid in state income taxes.

BASE:

The state does not want to start the program unless it has all the funds needed to buy the equipment, hire and train the staff, and complete the 5 years of alum treatments. To pay for this, Oklahoma taxpayers would pay a one-time tax added to their state income tax bill next year. The cost to your household would be $(**BIDAMNT**). The money would go into a special trust fund that can be used only for alum treatments. This is the only payment that would be required.

SCOPE:

The state does not want to start the program unless it has all the funds needed to buy the equipment, hire and train the staff, and complete the 5 years of alum treatments to the lake. To pay for this, Oklahoma taxpayers would pay a one-time tax added to their state income tax bill next year The cost to your household would be $_(BIDAMNT). The money would go into a special trust fund that can be used only for alum treatments. This is the only payment that would be required.

Interviewers reiterated that the alum treatments would work only if the state bans harmful spreading of poultry waste.

Because alum would work only after spreading of new poultry litter is stopped, there would be no alum treatments and no new tax unless the court bans spreading of litter.

Just before respondents were asked to vote, interviewers summarized the issues in voting.

BASE:

Voting for the program means (**PAUSE**) that it is worth it to you (**PAUSE**) for your household to pay the additional one-time tax of $ (**BIDAMT**) (**PAUSE**) to return the Illinois River, Flint Creek, Barren Fork Creek, the smaller creeks flowing into them, and Tenkiller Lake to what they were like in around 1960 40 years sooner.

SCOPE:

*Voting for the program means (**PAUSE**) that it is worth it to you (**PAUSE**) for your household to pay the additional one-time tax of $ (**BIDAMT**) (**PAUSE**) to return Tenkiller Lake to what it was like in around 1960 in 50 years rather than 60 years.*

Interviewers showed respondents a card listing reasons to vote "against" the program. The first reason to vote "against" reemphasized that many rivers and lakes in Oklahoma do not have excess algae.

On the other hand, there are reasons why you might vote against the alum treatments. For instance, you might think alum treatments are a bad idea. And, even if you think alum treatments are a good idea, you might vote against them because:

STOP **SHOW CARD N**

(**POINT**) Many rivers and lakes in Oklahoma do not have excess algae. STOP

A second reason to vote "against" is that other rivers and lakes in Oklahoma with excess algae would not be affected by these alum treatments.

(**POINT**) The other rivers and lakes in Oklahoma that do have excess algae would not be affected by these alum treatments. STOP

A third reason to vote "against" is that the river and lake will recover over time without alum treatments.

BASE:

(**POINT**) Natural processes will return the river and lake to what they were like in around 1960 in 50 to 60 years without alum treatments. STOP

SCOPE:

*(**POINT**) Natural processes will return the lake to what it was like in around 1960 in 60 years without alum treatments.* STOP

A fourth reason to vote "against" is that there may be other issues on which they would prefer to spend tax dollars.

(**POINT**) If the state does increase your taxes, you might prefer that it spend the money on other environmental issues or on issues other than the environment.

A fifth reason to vote "against" is respondents' budget constraints.

(**POINT**) Or the tax increase might be more than your household can afford to pay.

STOP UNTIL R IS FINISHED REVIEWING CARD N

FLIP CARD TO NEXT, BLANK PAGE

Immediately before respondents were asked to vote, they were reminded to consider the effectiveness of the program, its cost, and other things they could spend money on instead.

In a moment, I'm going to ask you to vote. Before you vote, please think about what the alum treatments would do, the cost that your household would have to pay, and the other things you could spend the money on instead.

Next, interviewers explained what it meant to vote "for" or "against" the alum treatment program.

Voting "for" the alum treatments means that you want them to be done beginning next year if a court bans future spreading of poultry litter by December of this year.

Voting "against" the alum treatments means that you do not want them to be done.

The first voting question, W1, asked respondents to make a decision to vote "for" or "against" the alum treatments given a specified cost to their household.

W1. Now please tell me whether you vote for or against the alum treatments, which would cost your household a one time additional tax of $ (**BIDAMT**).

When an interviewee gave an initial response such as "don't know," "not sure," or "would not vote," interviewers were instructed to encourage them to vote "for" or "against" the proposal. If respondents insisted that they would or could not vote, interviewers were instructed to accept this as a valid answer and to record the vote as "not sure."

Respondents who voted against the program were asked to explain the reasons for their vote.

W1A. Why did you vote against the alum treatments?

Respondents who were recorded as responding "not sure" were asked why they were unsure.

W2. Could you tell me why you aren't sure? (**BE SURE TO PROBE**)

Respondents who voted for the alum treatments were asked why they voted for the program.

W3. What would spreading alum do that made you vote for it? (***PROBE***: **"Can you be more specific about what you have in mind?" / "Anything else?" / "What would spreading alum do that made you vote for it?")**

Interviewers were instructed to use the appropriate probes for responses such as "It's a good thing."

4.8 Survey Part 7. Debriefing Questions

Part 7 contained debriefing questions, which documented some of the things that respondents were thinking when they voted and gauged their level of certainty about their vote.

4.8.1 Perception of injury, program, and interview

Respondents were asked Q24 if they voted "for" or "against" the alum treatments in W1. If respondents said they were "not sure" how they wanted to vote, the interviewer skipped to Q25. Interviewers showed respondents Card O, which listed a set of answer options and asked:

> **SHOW CARD O**
>
> **Q24**. How sure are you that you want to vote (**FOR/AGAINST**) the alum treatments? Not sure at all, slightly sure, moderately sure, very sure, or extremely sure?
>
> **FLIP CARD TO NEXT, BLANK PAGE**

In the next sequence of questions, respondents were asked to report what they had in mind or had assumed when they voted. The answers to these types of questions provided another check on respondent understanding and acceptance of the scenario (NOAA, 1993).

This sequence of questions was introduced with the following statement:

> Now I would like to ask you some questions about what you were thinking when you decided how to vote.

Interviewers then showed respondents Card P, which listed the response options for Q25 and Q26 (not serious at all, slightly serious, moderately serious, very serious, and extremely serious) and asked about perceived seriousness.

> **SHOW CARD P**
>
> **BASE:**
>
> **Q25.** After spreading of litter is banned, how serious did you think the effects of algae in the river would be if no alum treatments are done? Not serious at all, slightly serious, moderately serious, very serious, or extremely serious?

SCOPE:

***Q25**. After spreading of litter is banned, how serious did you think the effects of algae in the river would be? Not serious at all, slightly serious, moderately serious, very serious, or extremely serious?*

Q26. After spreading of litter is banned, how serious did you think the effects of algae in the lake would be if no alum treatments are done? Not serious at all, slightly serious, moderately serious, very serious, or extremely serious?

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The next question gauged whether respondents believed that alum treatments would be done only if a court bans harmful spreading of poultry waste.

Q27. When you decided how to vote, did you think that alum treatments would be done only if a court bans spreading of litter, or did you think that the alum treatments might be done anyway?

Respondents were then asked whether they thought that phosphorous had caused the changes to the river and lake the interviewer told them about.

Q28. When you decided how to vote, did you think that phosphorus had caused the changes in the river and lake I told you about, or did you think that phosphorus had not caused those changes?

Next, respondents were asked how quickly they thought the river would recover naturally after poultry waste is banned. This question was asked only in the base version.

Q29. When you decided how to vote, did you think that it would take about 50 years for the river to get back to around 1960 conditions without alum treatments, or did you think it might take less time or more time?

A similar question was asked about natural recovery for the lake.

BASE:

Q30. Now let's turn to the lake. I told you it would take about 60 years for the lake to return to what it was like in around 1960 without alum treatments. When you decided how to vote, did you think that it would take about 60 years, or did you think it would take less time or more time?

SCOPE:

Q30. *I told you it would take about 60 years for the lake to return to what it was like in around 1960 without alum treatments. When you decided how to vote, did you think that it would take about 60 years, or did you think it would take less time or more time?*

The next few questions (Q31-Q34) examined respondents' beliefs about the effectiveness of the program and the payment period.

SHOW CARD Q[30]

BASE:

Q31. When you decided how to vote, how well did you think that alum treatments would work at reducing algae in the water? Not well at all, slightly well, moderately well, very well, or extremely well?

SCOPE:

Q31. *When you decided how to vote, how well did you think that alum treatments would work at reducing algae in the lake? Not well at all, slightly well, moderately well, very well, or extremely well?*

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Q32. When you decided how to vote, did you think that if the alum treatments are done, your household would have to pay the amount I told you, more than that amount, or less than that amount?

BASE:

Q33. When you decided how to vote, did you think that the extra tax money would be used for alum treatments to reduce algae in only Tenkiller Lake and the Illinois River and creeks flowing into it, or did you think some of this money would be used clean up other rivers and lakes in Oklahoma as well?

30. Card Q listed the response options for Q31: not well at all, slightly well, moderately well, very well, and extremely well. See Appendices A.1 and A.2.

SCOPE:

Q33. *When you decided how to vote, did you think that the extra tax money would be used for alum treatments to reduce algae only in Tenkiller Lake, or did you think some of this money would be used to clean up other lakes in Oklahoma as well?*

BASE:

Q34. When you decided how to vote, did you think that if the alum treatments are done successfully for the Illinois River and Tenkiller Lake, this would or would not increase the chances that other rivers and lakes in Oklahoma would get alum treatments later?

SCOPE:

Q34*. When you decided how to vote, did you think that if the alum treatments are done successfully for Tenkiller Lake, this would or would not increase the chances that other lakes in Oklahoma would get alum treatments later?*

4.8.2 Trust, payment mechanism preferences, and respondent recreational activities

The next two questions (Q35-Q36) asked respondents about their trust in university scientists and the state government.

SHOW CARD R[31]

Q35. In general, how much do you believe what university scientists say? Not at all, a little, a moderate amount, a lot, or a great deal?

Q36. In general, how much do you believe what the people who run Oklahoma state government say? Not at all, a little, a moderate amount, a lot, or a great deal?

FLIP CARD TO NEXT, BLANK PAGE

The next question asked respondents whether they preferred to pay for new programs through higher taxes or through higher prices.

31. Card R listed response options for Q35 and Q36: Not at all, a little, a moderate amount, a lot, or a great deal. See Appendices A.1 and A.2.

Q37. There are different ways for people to pay for new programs to protect the environment. (PAUSE) One way is for the government to pay the cost. This will raise everyone's taxes. (PAUSE) The other way is for businesses to pay the cost. This will make prices go up for everyone.

If you had to choose, would you prefer to pay for new environmental programs through higher income taxes or through higher prices?

The next three questions asked respondents about their recreational activities.

Q38. During the last 12 months, how many times have you gone to any river or lake for sightseeing, fishing, boating, swimming, or any other type of recreation?

Q39. During the last 12 months, have you taken a trip away from home to observe birds or wildlife?

Q40. During a typical month, how many times do you watch television programs or read about wild animals or birds?

The final question in Part 7 asked respondents to report the degree to which they thought of themselves as an "environmentalist."

SHOW CARD S

Q41. Would you say you think of yourself not an environmentalist at all, slightly an environmentalist, a moderate environmentalist, a strong environmentalist, or a very strong environmentalist?

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4.9 Survey Part 8. Demographic Characteristics

4.9.1 Respondent household experience and demographic characteristics

Part 8 began by asking respondents questions about their household and personal characteristics.

> Now, I have just a few questions about your background.
>
> **Q42**. First, in total, how many years have you lived in Oklahoma?
>
> **Q43**. Do you intend to move outside of Oklahoma in the next year?
>
> **Q44**. In what month and year were you born?

Next, respondents were asked about their education. Interviewers coded responses into one of 16 categories, ranging from “no schooling completed” to “doctoral degree.”

> **Q45**. What is the highest degree or level of school you have completed?
>
> **MARK ONE BOX. IF CURRENTLY ENROLLED, MARK THE PREVIOUS GRADE OF HIGHEST DEGREE RECEIVED.**

Next, respondents were asked about other personal characteristics.

> **Q46.** Do you have children or stepchildren of any age, including anyone who lives outside your household?
>
> **Q47**. Do you have any grandchildren?
>
> **Q48.** Did anyone in your household pay Oklahoma state income taxes in 2007, either by having taxes withheld from your income or by sending money to the State with a tax form, or did no one in your household pay taxes last year?
>
> **Q49.** When you filed your state tax return for 2007, did you get a refund of all the money that you paid in before that?
>
> **Q50**. What language do you usually speak at home?
>
> **Q51.** Are you Spanish, Hispanic, or Latino?

Card P listed the response options for the race question. Respondents could choose one or more of the following: white, black or African American, American Indian or Alaska native, Asian, Native Hawaiian or other Pacific Islanders, or "other."

SHOW CARD T

Q52. Please choose one or more of the races shown here that you consider yourself to be.

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Respondents were asked to report their total family income in 2007. The question defined what respondents should include in their estimate, such as income from social security and profits from business or farms. The question also defined what was meant by "family." If respondents refused to provide a value, interviewers were instructed to go through a sequence of questions attempting to assign the respondent to an income category.

Q53. My next question is about your family income. This includes income from jobs, pensions, social security, interest, child support, dividends, profits from businesses or farms, or any other sources of income.

If you live alone, your family income is just your total income. If you live with other family members, your family income includes your total income plus the incomes of any of the family members who live with you.

During 2007, what was your total family income before taxes?

4.9.2 Payment difficulty and reassessment questions

The next question asked respondents how difficult it would be for their household to pay the amount of money mentioned in the vote question. The response options for this question were extremely difficult, very difficult, moderately difficult, slightly difficult, or not difficult at all.

SHOW CARD U

Q54. How difficult would it be for your household to actually pay the additional tax of $(**BIDAMT**)? Would it be extremely difficult, very difficult, moderately difficult, slightly difficult, or not difficult at all?

FLIP CARD TO NEXT, BLANK PAGE

Respondents who voted "for" the alum treatment program were asked to review their response to the vote question and were offered the opportunity to change their vote.

> **Q55.** Now that you've had time to think a bit more about the situation, I'd like to give you a chance to change your answer to the voting question if you like. Here is the question one more time:
>
> Now please tell me whether you vote for or against the alum treatments, which would cost your household a one time additional tax of $ **(BIDAMT)**.
>
> **Q55A.** Why is that?

Next, respondents were asked whether they felt pushed to vote one way or the other by the presentation of information. People who felt pushed were asked two follow-up questions (Q56A and Q56B), probing in which direction they felt pushed and why they felt this way.

> **Q56.** Thinking about all the information I gave you, overall, did it try to push you to vote one way or the other, or did it let you make up your own mind about which way to vote?
>
> **Q56A**. Which way did it try to push you to vote?
>
> **Q56B**. Please tell me what made you think that it tried to push you to vote one way or the other. **(PROBE: "Can you be more specific about what you have in mind?" "Anything else?")**

4.9.3 Other questions

The final question for respondents, Q57, asked for some basic contact information. Westat asks this standard question in surveys of this type for validation.

> **Q57.** In case my supervisor wants to confirm that we had this conversation, could you please tell me your full name and the best phone number to reach you at? (**RECORD FULL NAME AND PHONE NUMBER ON RECORD OF ACTIONS. DO NOT RECORD IT HERE**.)

4.10 Survey Part 9. Interviewer Evaluation Questions

At the end of each interview, interviewers answered some evaluation questions. Question D1 asked the interviewer to record the respondent's sex. Questions D2 through D9 asked for the interviewers' thoughts about the interview situation, how attentive (or distracted) the respondent was during the interview, and about any difficulties the respondent may have had.

D1. What is Respondent's SEX

D2. How distracted was the respondent?[32]

D3. How attentive was the respondent?

D4. How well did the respondent understand the material?

D5. Did the respondent say anything suggesting that he or she had any difficulty understanding what you told him or her?

D5A. Describe the difficulties.

D6. Did the respondent have any difficulty understanding the vote questions?

D6A. Describe the difficulties.

D7. How impatient was the respondent?[33]

D8. How seriously did the respondent think about the decision about how to vote?[34]

D9. Not counting you and the respondent, was anyone age 13 or older present when the respondent voted?

The final evaluation question encouraged interviewers to record any additional comments they had about the interview.

D10. Do you have any other comments about this interview?

32. Response options for D2, D3, and D4 were extremely, very, moderately, slightly, and not at all.

33. Response options were extremely impatient, very impatient, moderately impatient, slightly impatient, and not impatient at all.

34. Response options were extremely seriously, very seriously, moderately seriously, slightly seriously, and not at all seriously.

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5. Implementation of the Main Study

5.1 Introduction

Westat, Inc. administered the main study, with oversight by the Team. Westat is a leading statistical survey research organization that provides services to agencies of the U.S. Government, as well as businesses, foundations, and state and local governments. Founded in 1971, Westat is the largest survey firm of its kind in the United States, with more than 1,900 employees.[1]

For the main study, Westat:

- Selected a representative probability sample of Oklahoma residents (excluding a small proportion of the population residing in the sparsely-populated counties in the far western portion of the state)
- Created a list of addresses for housing units (HUs) in areas where the address list purchased from CIS [and derived from the U.S. Postal Service's (USPS') Delivery Sequence File] were deemed inadequate for sampling purposes
- Recruited and trained interviewers
- Supervised the data collection effort (conducted from September through December 2008)
- Validated that the interviews had actually been conducted
- Computed sampling weights
- Compiled the data sets (including both responses to closed-ended questions and verbatim responses to open-ended questions).

This chapter describes each of these activities in detail.

1. The only firms in the country larger than Westat focus on market research.

5.2 Sample Design and Selection

Westat used standard area probability methods to select the sample. Probability (or random) sampling is the preferred method for selecting a sample because it allows for unbiased projections to the population of interest (Kish, 1967). Other methods of sampling do not guarantee that population estimates will be unbiased.

Most large government surveys, such as the Current Population Survey used to derive the monthly unemployment statistics, are based on area probability sampling (U.S. Census Bureau, 2006). With this method, samples are usually selected from geographical areas in multiple stages, starting with large areas (such as counties or metropolitan areas), and then moving to successively smaller areas (such as blocks or individual addresses). Area sampling offers three main advantages over other probability methods for selecting samples of the general population. First, because the sample is clustered, it is cost-effective. The clustering of the sample in small areas, such as blocks, reduces data collection costs and allows for a larger sample size. Second, area probability samples provide the highest level of coverage of the population. In contrast, telephone samples omit a substantial proportion of the population from the outset (e.g., households without a telephone); so in principle, area probability samples provide much more complete coverage of the population (Groves et al., 2004). Finally, the combination of area probability sampling with face-to-face interviews generally leads to the highest response rates and the most accurate reporting. For these reasons, area probability sampling is typically used when it is important that the survey provide unbiased population estimates.

Westat selected the sample for the main study in four stages, beginning with Zip Code areas in the first stage of sampling, then blocks within the sample zip codes in the second stage, individual addresses on the sample blocks in the third stage, and finally selecting individual persons within sample households in the final stage. This type of multistage design is commonly used for general population surveys in the United States.

5.2.1 Population definition

The target population for the study was the civilian adult household population of Oklahoma. Adults were defined as persons 18 years of age or older (at the time the household was screened). The household population excludes persons living in group quarter settings, such as nursing homes, prisons, barracks, college dormitories, convents, or monasteries. College students living in off-campus housing were eligible to be interviewed if they were age 18 or older.

To reduce data collection costs, some counties in the western portion of the state were dropped prior to sampling. As shown in Figure 5.1, the geographical area sampled included the entire state except for Alfalfa, Beaver, Beckham, Cimarron, Dewey, Ellis, Greer, Harmon, Harper, Major, Roger Mills, Texas, Woods, and Woodward counties. Dropping these counties from the target population removed 24% of the geographic area of the state but only about 3% of the population. This figure is based on U.S. Census Bureau estimates of county populations, as of July 1, 2006.

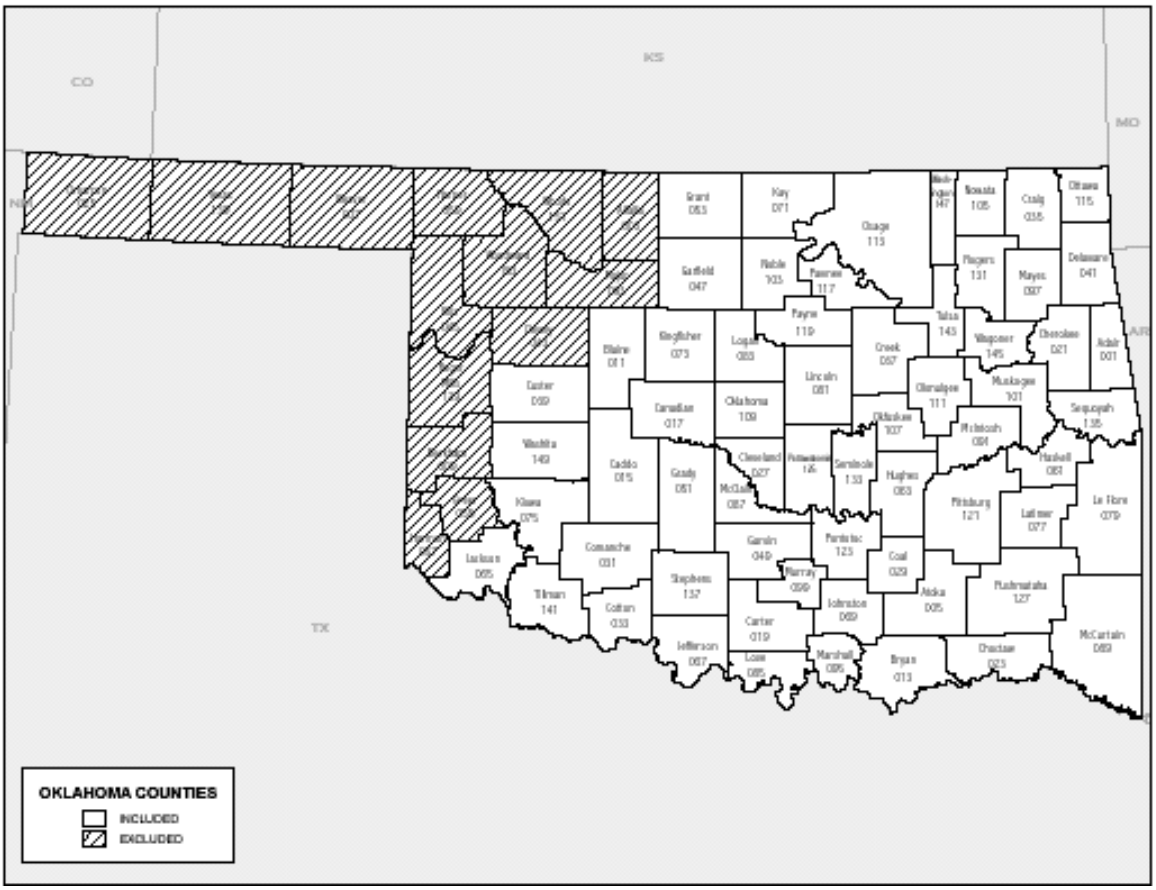

Figure 5.1. Map of Oklahoma, showing counties that were included and excluded from the survey.

5.2.2 First stage of sample selection

In sampling terminology, the largest units in a multistage area probability sample are called "primary sampling units," or PSUs. In this study, each of the PSUs consisted of the set of Census blocks linked to a single USPS Zip Code. Initial geocoding of Census blocks had produced a total of 518 PSUs, but 21 of these were very small, containing fewer than 100 housing units (HUs), according to Census 2000 data (more recent population figures were not available at the block level). Small units are inconvenient for sampling purposes (since the sample design may require more selections than the unit includes) so these 21 small PSUs were combined with nearby Zip Codes with similar characteristics, resulting in 497 initial PSUs, each with at least 100 HUs.

According to Census 2000 data, these 497 PSUs encompassed a total of 1,461,465 HUs. Since the desired sample size was 90 PSUs, each representing 1/90th of the population (or about 16,250 HUs), any of the 497 PSUs that contained at least 14,000 HUs in the target population were included in the sample with certainty (that is, with probability 1.0). Westat used this slightly lower cutoff (14,000 HUs) to ensure that borderline large PSUs were included in the sample. This step in the selection process yielded 12 certainty selections. The selection of certainty PSUs helps ensure proportionate representation to the most populous areas in the state.

To select the other 78 sample PSUs, Westat first grouped the remained 485 "noncertainty" PSUs into 39 sampling strata to ensure the representativeness of the sample. The PSUs were first placed into four regional groupings, based on county.[2] Within each region, the PSUs were further classified by their level of urbanicity (the percent of HUs in the PSU that were in urban areas) and percent minority (based on the percent of Hispanic and non-Hispanic, nonwhite persons in the PSU). Westat made an effort to form strata with approximately equal numbers of HUs. Finally, two PSUs were drawn from each of the 39 noncertainty strata, with probabilities proportional to the number of HUs. Table 5.1 shows the number of HUs (according to 2000 Census figures), number of strata, and the total number of noncertainty PSUs in each region.

2. Region 1 included Caddo, Carter, Comanche, Cotton, Custer, Garvin, Grady, Jackson, Jefferson, Kiowa, Love, McClain, Murray, Stephens, Tillman, and Washita counties. Region 2 included Blaine, Canadian, Cleveland, Garfield, Grant, Kay, Kingfisher, Logan, and Oklahoma counties. Region 3 included Adair, Cherokee, Craig, Creek, Delaware, Kay, Lincoln, Mayes, McIntosh, Muskogee, Noble, Nowata, Okfuskee, Okmulgee, Osage, Ottawa, Pawnee, Payne, Pottawatomie, Rogers, Sequoyah, Tulsa, Wagoner, and Washington counties. Region 4 included Atoka, Bryan, Choctaw, Coal, Haskell, Hughes, Johnston Latimer, LeFlore, Marshall, McCurtain, Pittsburg, Pontotoc, Pushmataha, and Seminole counties.

Table 5.1. Noncertainty PSU frame

Region	Number of HUs	Number of strata	Number of PSUs
1	164,579	5	108
2	387,973	12	103
3	550,818	17	170
4	162,081	5	104
Total	1,265,451	39	485

5.2.3 Second stage of sample selection

Zip Code areas are too large for data collection purposes. To reduce data collection costs, most surveys select clusters of housing units selected from the same second stage units, or "segments" that typically consist of one or more Census blocks. For each of the sample PSUs, Westat defined a set of segments using block-level data from Census 2000. Each block had a measure of size that reflected either the number of HUs in the segment (according to the 2000 census) or the number of addresses (according to the USPS address lists). Westat obtained the address lists for the sample PSUs from CIS, the same vendor who provided the address lists for the pilot studies. Each address was geocoded to determine the Census blocks on which they belong. In total, 713,012 addresses were purchased for the Zip Codes associated with the 90 sample PSUs and 640,880 of these could be assigned to a Census block. (Most of the remaining addresses were Post Office box numbers.)

Westat created block records that included the Census HU count, the number of USPS addresses geocoded into the block, and block identifying information. Each block record was assigned the larger of either the Census HU count or the number of USPS addresses as its measure of size. To avoid selecting areas with few housing units, Westat imposed a minimum size requirement on the segments (as it had with the PSUs). Blocks with a measure of size of less than 30 were combined with nearby blocks to form segments that met the minimum requirement of 30 HUs.

Westat selected the second-stage sample by first sorting the list of segments by PSU and then sorting within PSU, by the segment measure of size (which was the sum of the size measures for all the blocks in the segment). A sample of 420 segments was drawn from the list with probabilities proportional to the segment measure of size. Probability proportional to size sampling is often used in surveys, because it has the intuitive appeal of giving larger areas greater chance of selection than smaller areas, but yields close to an equal probability sample at the household level.

Segments were classified into two groups based on the ratio of the number of addresses geocoded into the segment to the number of HUs reported in the 2000 Census. Segments for which this ratio exceeded 75% were designated "address list" segments (there were 282 of these), and the remaining 138 sample segments were designated as "field listed" segments. The address list was deemed adequate for sampling purposes in the first group of segments, but not for segments in the second group. In the field listed group, a lister would be assigned to compile a list of the HUs in the segment.

5.2.4 Third stage of sample selection

Within the address list segments, addresses were sampled directly from the list of USPS addresses that had been geocoded to that segment. Westat selected ten addresses in each of the address list segments, resulting in a total sample of 2,820 addresses.

For the field listed segments, Westat field staff canvassed the segment to create a list of the HUs within the segment. These lists were then used to select a sample of eight to 20 addresses. One segment slated for field listing did not contain any HUs, but only a temporary campground. Two other segments designated for field listing were inside gated communities and field staff could not gain entry to list the HUs. From the remaining field listed segments, 1,386 HUs were selected. Westat compared the addresses from the field listed segments with the list of purchased addresses. In some instances, the same addresses were found on the address lists for segments designated as address list segments. When this occurred, Westat deleted the duplicate from the field list sample to avoid giving these HUs two chances of selection (one in the address list segment and another in the field list segment). A total of 99 cases were deleted during this process, leaving an initial sample for the field listed segments of 1,287 HUs.

At the conclusion of the third stage, the initial sample included 4,107 HUs (2,820 from the address list segments and 1,287 from the segments that were field listed). Subsequently, 87 HUs were added as a result of the quality control procedures described in the next section giving a total of 4,194 HUs. The purpose of these quality assurance procedures was to correct for any omissions from either the address lists or the field listings.

5.2.5 Checking the lists of addresses

No list of addresses is perfect (in part because new housing units are always being built). As a result, most area probability surveys incorporate quality control procedures for capturing units that were omitted from the address list. Westat minimized the chances of missing HUs in field listed segments by conducting a thorough check of the addresses listed in a random subsample of segments. Addresses that were missed or belonged to newly built units were then added to the

sample. This step eliminated any coverage bias from missed housing units in the field listed segments.

Westat used a slightly different procedure to check for missing units in the address segments (see Table 5.2). Under the modified procedure, field staff prepared a list of addresses for any HUs in the selected segment that were not included in the USPS-derived address list for the segment. However, as Dohrmann et al. (2006) pointed out, some of the "missed" units found in this way may not actually be missed but may simply have been assigned to the wrong area due to geocoding errors. For this reason, Westat compared any new addresses found in the address segments with the lists of USPS addresses in neighboring segments. If the "missed" unit appeared in the list of addresses for another address segment, it was not added to the sample because such units already had a chance of being selected in the segment to which they had been geocoded.

Table 5.2. Quality control procedures for missed units

Type of segment	Number of sample segments	Number of addresses in initial sample	Number added in QC procedures	Total number of sample addresses
Address	282	2,820	79	2,899
Field listed	138	1,287	8	1,295
Total	420	4,107	87	4,194

In both types of segments, additional checks were made for missed units in a randomly selected subsample of apartment buildings. Finally, at all the sampled addresses, interviewers attempted to identify separate living quarters (such as basement apartments) that would not otherwise have been listed in either the address or field listed segments.

Implementing these quality control procedures across both types of segments added a total of 87 HUs to the sample.

Finally, Westat compared the selections with addresses of certain persons employed by or under contract to the defendants to the lawsuit. These addresses were not to be included in the sample. None of the addresses matched and no selections were removed.

5.2.6 Subsampling at the third stage of selection

In mid-October, it became apparent that more HUs had been selected for the base interview than were needed to meet the sample size target. To reduce the number of samples, Westat selected a random subsample of the cases that were still pending (approximately 3,000); completed cases, known ineligibles, and final refusals were excluded from the subsampling process. At total 931 randomly selected cases were dropped from the sample at this point. The remaining 3,263 sample HUs were retained in the final screening sample.

5.2.7 Final stage of sample selection

In the final stage of sampling, a roster of eligible adults living in each sampled HU was obtained during a screening interview. To be eligible for the base or scope interview, a member of the household had to be 18 years of age or older and living at the dwelling at the time of screening. Once the screener had been completed the household was randomly assigned to get the main or scope instrument and was also randomly assigned a bid amount.

The screening program also randomly selected one of the eligible adults in each HU to complete the base or scope interview. Screening interviews were completed at 1,793 of the 3,263 sample households.

5.2.8 Weights

Survey data may be weighted for several reasons. First, the sample members often have different selection probabilities. For example, the design for the main study called for the selection of a single respondent from each sample household. This gives a higher selection probability to persons who live by themselves, so that they are overrepresented in the sample relative to the population. Weighting compensates for this overrepresentation by assigning more weight to persons selected that had lower probabilities of selection. Weighting is also used to compensate for differences in response rates across different subgroups of the sample. Differential nonresponse can mean that the composition of the sample of *respondents* by subgroup differs systematically from the composition of the population. Finally, weights are often assigned to compensate for chance differences between the sample and the population of interest. The weights applied in the main study were calculated in three steps. The first two steps were designed to adjust for differential selection probabilities and for differential nonresponse; the third step brought the sample into line with independent population figures for the state of Oklahoma. Three separate weights were calculated — one for all the respondents, one for those who completed the base questionnaire, and one for those who completed the scope questionnaire. Below, we describe the weighting procedures used for all respondents. Similar methods were

used to create weights for the subsamples of respondents who completed the base and scope questionnaires.

Calculation of base weights. The first step involved developing a base weight that represented the inverse of the person's selection probability. This initial weight (w_1) reflected all four stages of selection described earlier (that is, the selection of sample PSUs, segments, dwellings, and individual respondents); in addition, the initial weight took into account the subsampling procedure described in Section 5.2.6. The base weight was a product of five factors:

$$w_{1ijk} = \frac{1}{\pi_i} x \frac{1}{\pi_{1ij}} x \frac{1}{\pi_{2ij}} x \frac{1}{n_{ijk}} x \frac{1}{s_{ijk}}.$$

The first factor reflects the selection probability for PSU i (π_i); the second reflects the selection probability for segment j conditional on the selection of PSU i (π_{1ij}); the third, the sampling rate for addresses within that segment (π_{2ij}); the fourth factor reflects the selection probability for an individual from household k within segment j and PSU i (and n_{ijk} represents the number of members of that household who were eligible for the survey); and the final factor reflects the subsampling probability(s_{ijk}) – that is, the probability that a unit was retained in the sample after subsampling. If the fourth factor is dropped, the initial weight becomes a household-level weight rather than a person-level weight.

Adjusting for nonresponse. The nonresponse adjustment was made in two stages. Westat first adjusted the base weights for screener nonresponse. Twelve nonresponse adjustment cells were defined by region, type of segment (urban vs. rural), and other segment-level variables derived from the Census 2000 block files. The final cells were developed using a CHAID analysis. The screener nonresponse adjustment factor (R_{DU}^{NR}) is the inverse of the weighted response rate within the adjustment cell. A similar adjustment factor (R_{SP}^{PS}) was computed to compensate for nonresponse after the screener interview had been completed. Eight adjustment cells were defined by age, sex, race/ethnicity, and selected segment-level variables. (Westat's report on the main study in Appendix C describes the nonresponse adjustments in more detail.) Again, the base and scope interview nonresponse adjustment factor was the inverse of the weighted response rate to the base and scope interview (conditional on completion of the screener interview) within the adjustment cell. For respondents, the non-response adjusted weight (w_2) was the product of the base weight and the two adjustment factors. For nonrespondents, the adjusted weight was zero.

Adjusting to population figures. Westat made a final adjustment to the weights to align the weighted sample counts to independent population counts derived from the 2007 American

Community Survey (ACS). This was done using a ratio-raking algorithm, in which the weighted sample marginal totals for certain variables were iteratively adjusted to agree with the corresponding population counts. The population marginals included ten age-sex groups and five race/ethnicity categories.

Replicate weighting. To make it possible to use replication methods for estimating the variances of statistics derived from the survey data, Westat computed replicate weights. Jackknife replicates were created by dropping one PSU from a particular stratum, and then doubling the weight of the cases in the PSU that was retained in that stratum. Starting with stratum 1, a total of 69 jackknife replicates were formed. Each jackknife replicate was weighted using the same procedures described earlier for the full sample. This resulted in a total of 70 weights for each respondent (a full-sample weight and 70 replicate weights). Separate sets of weights were developed for the base, scope, and common questionnaire items.

5.3 Interviewer Recruitment, Training, and Supervision

5.3.1 Interviewer recruitment

A Westat field supervisor oversaw the recruitment effort. A total of 42 interviewers were recruited for the study; 19 were local residents and 23 were "travelers" who were brought in from outside the state. Eight of the local interviewers had been involved in field work for one or both of the pilot studies.

5.3.2 Interviewer training

Westat and the Team conducted interviewer training in Oklahoma City, on September 17-19. The training was led by Michael Shea (the Westat Project Director) and Sherry Sanborne, who had overall responsibility for the field effort. Two members of the Team, David Chapman and Jon Krosnick, also participated in the training. The interviewers were not informed about the role of the research in the ongoing litigation.

On the first day of training the instructors:

- Introduced the study
- Described the sample design
- Provided tips for getting in the door
- Introduced the advance letter and other recruitment materials
- Gave the interviewers practice ("role plays") in administering the screening interview
- Provided training on the CAPI software (in series of "lessons" that demonstrated directed features of the software).

On the second day of training, emphasis shifted to the base questionnaire. Dr. Jon Krosnick introduced the questionnaire, and he and David Chapman read through the entire instrument twice, demonstrating the show cards and maps. The remainder of the day mostly involved "role play" by the interviewers (where they practiced administering the base questionnaire) and an associated question-and-answer session. The day concluded with a session given by Dr. Krosnick on methods for gaining cooperation from sample members.

The final day of training included:

- Additional role play exercises, in which interviewers practiced both the screener and the base interview
- Training to locate hidden housing units and complete the record of contacts and the non-interview reports
- Specifics on how to transmit the completed cases electronically
- Additional information about other administrative matters.

To maintain production, Westat conducted "attrition" training in its Rockville, MD Offices on November 11-14. This second training followed an agenda similar to the first. Dr. Krosnick again led several of the training sessions. Three interviewers were trained in November and began field work immediately afterward.

Both the initial and attrition training covered a number of key issues on the presentation of the questions. These included the use of visual aids, responses to frequently asked questions, the best method for presenting information to respondents, recording verbatim responses, and probing unclear answers.

Visual aids. When instructed to do so in the CAPI program, interviewers showed visual aids to respondents. The team created and pretested these visual aids to help respondents understand key aspects of the scenario and to maintain respondent engagement. The visual aids for both the base and scope scenarios included one flip chart (8 ½ × 14), six laminated cards (also 8 ½ × 14), and a booklet with 21 show cards (maps, timelines, and picture sets). The laminated cards included four maps and two timelines and were bound by a ½ inch ring. The interviewers used the flip chart and laminated cards if they had to sit far away from the respondent during the interview.

Frequently asked questions (FAQs). Respondents were told that the State of Oklahoma was conducting the study to get "opinions about important issues facing the state these days." If respondents asked for more information about the survey, the interviewers were instructed to use only the replies provided on a FAQ card. The FAQ card listed questions respondents might ask before, during, or after the interview and gave answers to be provided for those questions. For example, if asked, "What is this survey about?" interviewers were instructed to say "The purpose of this study is to ask people who live in Oklahoma for their opinions about important issues facing the state these days." If asked, "Why should I participate?," interviewers were instructed to say "Your answers will help the state of Oklahoma understand how the people of Oklahoma feel about problems affecting the state and what they want done to address those problems."

Presenting information. During training, interviewers learned to read the survey material in a way that would maintain respondent interest and enhance comprehension. Below is an excerpt from the interviewers' training manual that emphasized this theme:

> This survey is different from many other surveys you may have worked on in the past. You will give a lot of information to respondents about the river and lake, about the condition of the water, about the fish that live in the river and lake, and about a program to reduce the effects of the phosphorus on the river and lake. You'll read this information to the respondents, and it is very important that you read the information slowly and clearly and in a neutral way, exactly as it is written. Much of the information is illustrated or summarized on show cards. The purpose of all the information is to let people make up their own minds about the program – it's important to avoid pushing people to vote for or against the program (Shea et al., 2008).

During interviewer training sessions, leaders repeatedly reminded interviewers to present the information in a neutral fashion and let respondents make up their own minds about their answers.

Recording verbatim responses. At several times during the interview, respondents were asked open-ended questions, which allowed them to answer in their own words rather than requiring they select a response from a set of offered response choices. Also, respondents sometimes offered spontaneous open-ended comments during the interviews. Westat instructed interviewers to type exactly what the respondent said, asking the respondent to pause, if necessary, so the interviewer could completely record an answer or comment. The interviewers' training manual (and the oral training session) emphasized the importance of accurately recording comments made during the interview. Interviewers practiced typing open-ended answers and comments, referred to as verbatim responses, during role-play sessions in the interviewer training.

Probing. During training sessions, interviewers learned how to use nondirective probing techniques to clarify respondent answers to open-ended (or close-ended) questions. These techniques were to be used if a respondent's answer was vague or did not adequately answer a question. Nondirective probing is a standard procedure in contemporary survey research (Groves et al., 2004). It requires the interviewer to ask the respondent to elaborate or think about an incomplete answer without influencing the content of the answer. Each interviewer received question-by-question instructions that provided probes that could be asked.

5.3.3 Supervision

Westat assigned two central office staff to oversee the interviewing effort and two additional staff to provide support on computer issues. In addition, three field supervisors were in Oklahoma and had more frequent contact with the interviewers. One of the three field supervisors was primarily responsible for the interviewers brought in from out of state (the "travelers"). The other two supervisors were responsible for the in-state interviewers, with one supervisor overseeing the interviewers in the Tulsa area and the other overseeing those in the Oklahoma City area.

The supervisory staff was tasked to promote high levels of productivity, help interviewers achieve high completion rates, and to reassign cases from one interviewer to another as needed. The field supervisors also monitored interviewer hours and expenses, and two of the supervisors also conducted interviews.

5.4 Main Study Data Collection

5.4.1 Data collection

Field work on the main study began in August, when field staff listed the 138 segments for which the addresses purchased from CIS did not appear adequate for sampling purposes. These segments were in rural areas and the addresses were mainly rural delivery route addresses. The listing operation was completed in about three weeks.

Interviewing started immediately after completion of the interviewer training on September 20 and ended on December 8. Each interviewer had an assignment consisting of 50 or more sample addresses. Interviewers worked the urban areas (Tulsa and Oklahoma City) first and then moved on to the rural segments. Field supervisors transferred cases among the interviewers as needed to maintain productivity. A second, "attrition" training was held in the second week of November to replace interviewers who had dropped out by then.

The interview consisted of two parts, a screening interview (or screener) and the base or scope interview. After verifying that they had located the sample address, the interviewers conducted the screening interview. The screening interview was administered using a computer-assisted personal interviewing (CAPI) program that gathered basic information about each adult member living in the sample housing unit. When there was more than one adult household member, the CAPI program randomly selected one of them to be the respondent for the base or scope questionnaire. The screener took five to eight minutes to complete. The base interview was then administered also via CAPI and the use of visual aids, including maps, photographs, timelines, sets of response categories, and show cards summarizing key information. The base and scope interview generally took between 30 and 60 minutes to complete.

A number of things were done to achieve a high completion rate:

- An advance letter (example text is shown in Appendix C) describing the study was sent to sample addresses prior to the interviewer's first visit;
- When no one was at home, interviewers left a "Sorry I Missed You" card (see Appendix C) with their name and telephone number;
- Central office staff obtained names and telephone numbers for 728 of the sample addresses and forwarded these to the interviewers to make it easier for them to contact sample households;
- Refusal conversion letters were sent via FedEx to households where potential respondents had expressed reluctance to take part in the study. This was done in late

October and again in early December (for cases that were contacted after the first set of refusal conversion letters were sent out).

- Two members of the Team (Dr. Krosnick and Dr. Tourangeau) made refusal conversion telephone calls.

Overall, 1,793 cases completed screening interviews; an additional 378 of the sample addresses were vacant or did not exist and thus were ineligible. A total of 1,637 cases completed the base or scope interview. Section 5.4.3 provided a more detailed discussion of the response rates for the study.

As a quality control measure, field supervisors and home office staff carried out "validation" interviews to verify that the completed base or scope interviews had actually been done. The bulk of the validation interviews were done by telephone, but, when a telephone number was not provided, a face-to-face validation interview was done. The validation interviews were brief and confirmed that an interview had in fact been done, asking about the purpose and content of the interview. About 15% of each interviewer's completed cases were validated.

5.4.2 Response rate

The final sample included 3,263 addresses. Screeners were completed at 1,793 of these addresses, 378 of them were determined to be ineligible (these were mostly vacant housing units or structures that were not housing units at all), and the remainder were eligible screener nonrespondents. The unweighted response rate to the screener (that is, the proportion of the eligible households that completed a screening interview) was 62.1%. The weighted response rate (in which the weights are the base weights described in Section 5.2.8) was 58.1%.

Of the 1,793 households that completed the screener, 1,637, or 91.3%, also completed the base or scope questionnaire. (The corresponding weighted response was 89.3%). The overall response rate, taking into account nonresponse to both the screening and base and scope interviews, was 56.7% (that is, 62.1% × 91.3%); the overall weighted response rate was 51.9% (58.1% × 89.3%).

Appendix F presents several analyses examining whether nonresponse introduced bias into the survey estimates. We found little evidence that nonresponse bias had an impact on the main study results.

5.5 Data Processing

The use of CAPI software greatly reduced the amount of back-end data processing needed to produce a final data set. Most of Westat's data cleaning effort involved correcting obvious typos and other errors in the verbatim responses. In addition, creation of the final data set also included the imputation of missing data and the coding of the open-ended responses.

Imputation refers to replacing missing values with plausible or predicted values. The missing values result from questions that respondents were unwilling or unable to answer. Imputation is useful for reducing any biases introduced into the results by item nonresponse and also for maintaining the number of cases that can be used in the multivariate analyses. Although there are several methods for imputing missing values, two methods are commonly used in surveys and give similar results — regression-based imputation and hot deck imputation (see, for example, the discussion in Little and Rubin, 2002). For this study, the Team used hot deck procedures to fill in missing values for key variables.

In hot deck imputation, cases are grouped into imputation cells based on variables that are available both for the cases with complete data and those with missing values. The cells are formed so that cases in the same cell are expected to have similar values on the variable of interest. For example, to impute missing values for annual income, researchers might use imputation cells based on the respondent's employment status, occupation, and educational attainment. Once cases have been grouped into imputation cells, a random "donor" (a case with a valid value on the variable of interest) is selected and that case's value is used as the imputed value for the case with missing data. The key variable for which the Team imputed values was income. Appendix E gives a more detailed description of the procedure used for inputting missing income values.

The base and scope interview included a number of questions where respondents were asked to formulate answers in their own words. For example, respondents were asked to explain why they had voted the way they did. The Team developed a coding scheme to permit quantitative analyses of these open-ended responses. (Appendix D.2.1 lists the verbatim responses and gives a description of the development of the coding scheme.) The coding manual (in Appendix D.2.2) gave detailed instructions to the coders for classifying these open-ended responses. Tables 6.2 and 6.3 in the next chapter show some of the results based on the coding of reasons for voting for or against the alum treatments.

A total of 12 coders carried out the coding under the supervision of Dr. Amanda Scott. The coders were experienced, and had Bachelor's or more advanced degrees, or both. Tests of inter-coder agreement indicated higher than 95% agreement on the assignment of codes.

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6. Distribution of Votes and Tests of Validity

This chapter presents the responses to the valuation question, and shows that the results are consistent with people's beliefs and characteristics, and with theoretical expectations. Further, the results are shown to be robust to a series of sensitivity analyses. In order to characterize the population of interest – the public of Oklahoma – and adjust for other sampling issues, all results in this chapter are based on weighted data, using the base weights, as described in Chapter 5. All variances are estimated using a jackknife procedure based on the 69 replicate weights described in Chapter 5.

6.1 Votes in the Base Survey

Question W1 of the survey asked respondents, "Now please tell me whether you vote 'for' or 'against' the alum treatments, which would cost your household a one time additional tax of $ (BIDAMT)." Six different dollar amounts were randomly assigned to the surveys: $10, $45, $80, $125, $205, and $405.

Of the 1,093 respondents to the base survey, 659 (60.3%) voted "for" the program. The respondents who voted "for" the program were later offered an opportunity to change their votes. Twelve (1.8%) of the 659 respondents chose to change their vote from "for" to "against," and these respondents were treated as having voted "against" the program in all analyses in this chapter. All "don't know" responses are also treated as votes "against" the program. Overall, after the changed and "don't know" votes were accounted for, 58.4% of respondents voted "for" the program.

The results for the Base version of the survey are presented in Table 6.1.

Table 6.1. Respondent votes "for" the alum treatment program

Tax Amount	Percent voting "for"	Lower 95% Confidence Interval	Upper 95% Confidence Interval
$10	81.5%	75.7%	87.2%
$45	70.1%	62.5%	77.8%
$80	60.2%	50.1%	70.3%
$125	61.5%	54.1%	68.9%
$205	43.5%	34.9%	52.1%
$405	34.2%	26.6%	41.7%
Overall	58.4%	54.7%	62.1%

As expected, the proportion of votes "for" the program was highest at the lowest cost ($10) and lowest at the highest cost ($405). An F test rejected the hypothesis that the votes did not vary as cost amounts changed from one respondent to the next, indicating that votes were responsive to cost. ($F(4.69,319.07) = 18.46$, $p < 0.001$, $N = 1,093$).[1]

A logistic regression of votes on dollar cost only yielded the expected statistically significant negative coefficient ($b = -0.005$, $p < 0.001$, $N = 1,093$), indicating that votes were responsive in the theoretically appropriate direction.

1. The five joint hypotheses in the F test were: P(10)-P(45) = 0, P(45)-P(80) = 0, P(125)-P(80) = 0, P(205)-P(125) = 0, and P(405)-P(205) = 0. F tests were also run on each equation separately. Four of the five individual tests found that votes were significantly different at the 10% level. The only single comparison that did not find a significant difference was P(80)-P(125) = 0.

Figure 6.1 shows the voting data from Table 6.1, including confidence intervals and a trend line based on a second order polynomial.

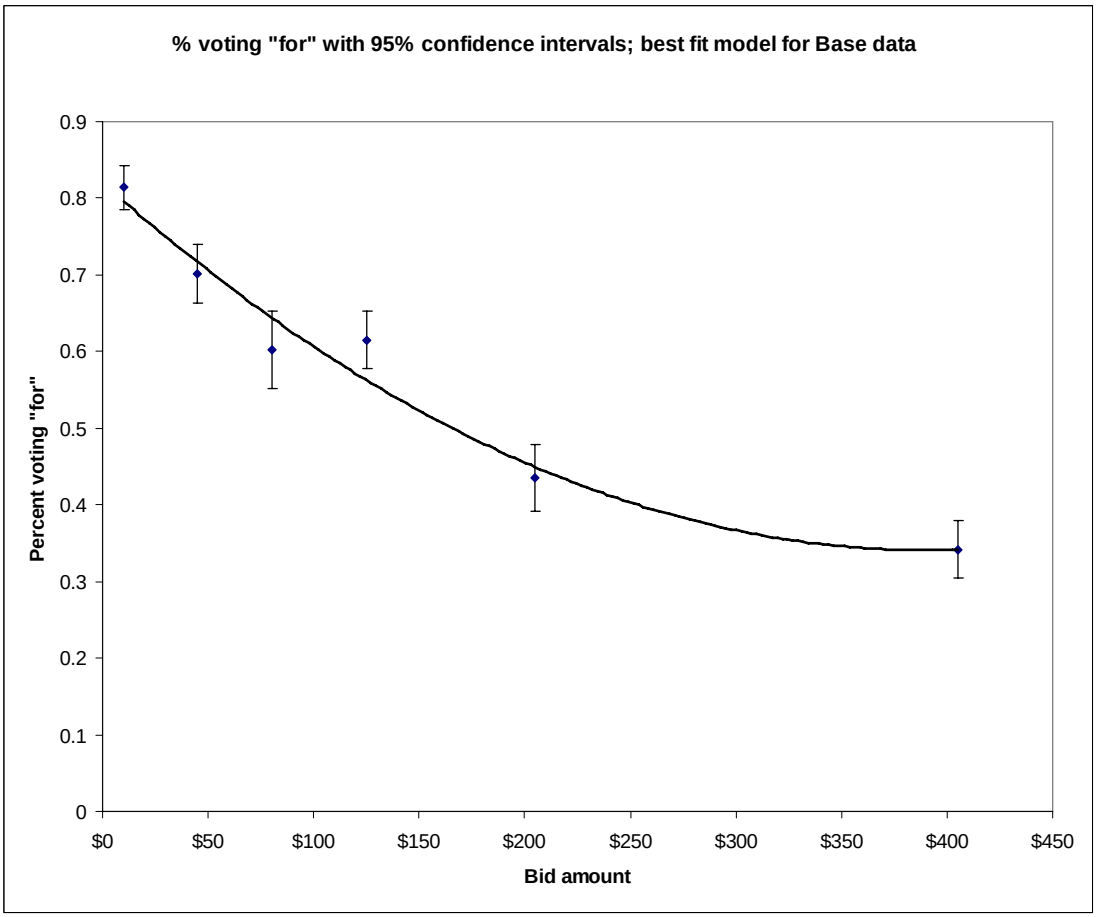

Figure 6.1. Proportion of votes "for" the program by cost (vertical lines indicate the 95% confidence intervals of the proportions).

6.2 Reasons for Voting "For" or "Against" the Program

After respondents voted, they were asked to explain why they voted as they did. Each open-ended answer was assigned to a response category by a team of coders.[2]

Of the respondents who were given the base survey, the most common reason given for voting "for" the program was that it would benefit the river and lake (offered by 39.6% of the respondents). An example response was, "It would be clearing up the river and lakes." The next most common response suggested the program would benefit other people (offered by 22.2%). For example, one person said, "Our future generations are important." This reflects *nonuse value.* An example of *use value* would be when respondents said they would benefit from the program (offered by 4.2% of respondents), such as by improving opportunities for fishing. The percentage of respondents providing positive responses in each coding category is listed in Table 6.2. The complete set of verbatim responses is provided in Appendix D.

Table 6.2. Reasons for voting "for" the program

Coding category	% of respondents[a] (N = 659)
Program will help area around river and lake	39.6%
Program will benefit others	22.2%
Program will speed up the recovery	20.6%
Program will bring lake back to earlier state	11.5%
Other	9.0%
Program reduces risk to human health	4.7%
Respondent would benefit from program	4.2%
Program will protect environment in general	4.2%
Respondent is concerned about environment	2.6%
Program has other benefits than cleaning water	2.3%
Society is responsible for fixing problem	0.9%
Others in household concerned about environment	0.2%
Don't know/ Doesn't remember	0.2%

a. Percentages can add up to more than 100% because individuals could provide more than one reason

The most common reasons given for voting "against" the program involved the financial expense: the cost was too high for the respondent or his/her household (18.0%), the cost was too high for specific people other than the respondent and/or his/her household (6.5%), the cost was too high, without specifying for whom (9.4%), and the benefits of the program were not worth the cost (2.4%; see Table 6.3). For example, one respondent said, "Can't afford it. That's the

2. Coding of open-ended responses was done by the Strategy Team.

only reason." The next most common reason was that other issues were more important (15.1%). Thirteen point two percent said that nature would solve the problem on its own. Nine point six percent said they did not want to pay more taxes. Seven point four percent of respondents said that they were not sure the program would work. And smaller numbers of respondents gave other reasons listed in Table 6.3.

Table 6.3. Reasons for voting "against" the program

Coding category	% of respondents[a] (N = 417)
Cost is too high for respondent/household	18.0%
Other issues are more important	15.1%
Let nature solve the problem	13.2%
Does not want to pay more taxes	9.6%
Cost of program is too high	9.4%
Other	8.6%
Not sure if the program would work	7.4%
Cost too high for others	6.5%
Program only helps a few rivers and/or lakes	6.2%
Treatments could have unknown bad effects	6.0%
Does not care about the problem	5.8%
Does not like way payment would be collected	5.0%
Problem could/should be solved other ways	4.6%
Polluters should pay	3.6%
Someone else should pay	2.9%
Money might be used for other purposes	2.4%
Benefits are not worth cost	2.4%
People not near lake won't want to pay	1.9%
Does not trust government	1.4%
Program does not do enough	1.2%
Users should pay	1.2%
Don't know/ Doesn't remember	0.2%
Refused	0.2%

a. Percentages can add up to more than 100% because individuals could provide more than one reason

The very small number of respondents who answered "don't know" were asked to further explain their response. The most common reason given was that the cost was too high. Other reasons mentioned were predominantly ones to vote "against" the program, as shown in Table 6.4.

Table 6.4. Could you tell me why you aren't sure?

Coding category	% of respondents[a] (N = 17)
Other	29.4%
Cost too high for others	17.6%
Cost is too high for Respondent/Household	11.8%
Users should pay	5.9%
Does not like way payment would be collected	5.9%
Not sure if the program would work	5.9%
Money might be used for other purposes	5.9%
Problem could/should be solved other ways	5.9%
Cost of program is too high	5.9%
Does not want to pay more taxes	5.9%

a. Percentages can add up to more than 100% because individuals could provide more than one reason

The verbatim responses indicated that the respondents took the valuation question seriously and supported their votes – whether positive, negative, or "don't know" – with sensible and theoretically appropriate reasoning.

6.3 Scenario Acceptance

This section describes how respondents perceived the scenario presented in the survey and discusses how their perceptions are related to their votes. The results show that, item-by-item, most respondents accepted the various aspects of the scenario and that as perceptions varied, votes varied accordingly.

All percentages in this section are based on weighted data. Numerical results (the *N*'s) are based on unweighted data.

6.3.1 Program effectiveness

Respondents were asked, "When you decided how to vote, how well did you think that alum treatments would work at reducing algae in the water?" (Q31) Fifteen point nine percent of respondents answered "extremely well," and 45.0% said "very well." Another 25.5% said "moderately well, 7.1% said "slightly well," and 3.0% said "not well at all" (see column 2 of Table 6.5).

As expected, the more effective the respondent thought the program would be, the more likely he or she was to vote "for" it (see column 3 of Table 6.5). For example, whereas 83.3% of people who thought the program would work extremely well voted "for" it, 69.0% of people who said it would work very well voted "for" it, 42.1% of people who thought it would work moderately well voted "for" it, and smaller proportions of people who thought it would work less well voted "for" it. The relation between beliefs about the program's effectiveness and votes is statistically significant [$F(4.75, 322.80) = 28.64$, $p < 0.001$].

Table 6.5. How well alum treatments would work

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
Not well at all	3.0%	27.0% (32)
Slightly well	7.1%	22.4% (89)
Moderately well	25.5%	42.1% (255)
Very well	45.0%	69.0% (502)
Extremely well	15.9%	83.3% (171)
Don't know/refused	3.6%	27.5% (44)
Total	100.0%	

6.3.2 Natural recovery time

Respondents were asked two questions about the speed with which they thought the river and lake would recover on their own:

> "When you decided how to vote, did you think that it would take about 50 years for the river to get back to around 1960 conditions without alum treatments, or did you think it might take less time or more time?" (Q29)
>
> "Now let's turn to the lake. I told you it would take about 60 years for the lake to return to what it was like in 1960 without alum treatments. When you decided how to vote, did you think that it would take about 60 years, or did you think it would take less time or more time?" (Q30)

Thirty-one percent of respondents said they thought the river would recover on its own in less than 50 years (see column 2 of Table 6.6). Thirty-eight point five percent said they thought the river would recover on its own in about 50 years, and 24.3% said they thought it would take more time for the river to recover on its own.

Table 6.6. River recovery time

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
Less time	31.4%	41.2% (340)
About 50 years	38.5%	65.5% (406)
More time	24.3%	74.7% (272)
Don't know/refused	5.8%	35.8% (75)
Total	100.0%	

As expected, the longer respondents thought it would take for the river to recover on its own, the more likely they were to vote "for" the program. Forty-one point two percent of respondents who thought the river would recover on its own in less than 50 years voted "for" the program (see column 3 in Table 6.6). Sixty-five point five percent of respondents who thought the river would recover on its own in about 50 years voted "for" the program. And 74.7% of respondents who thought the river would recover on its own more slowly voted "for" the program. The relation between beliefs about river recovery time and votes is statistically significant [$F(2.76, 187.52) = 28.07$, $p < 0.001$].

Thirty-one point four percent of respondents said they thought the lake would recover on its own in less than 60 years (see column 2 in Table 6.7). Thirty-eight point six percent said they thought the lake would recover on its own in about 60 years, and 25.1% said they thought it would take longer for the lake to recover on its own.

As expected, the longer respondents thought it would take for the lake to recover on its own, the more likely they were to vote "for" the program. Forty-one point six percent of respondents who thought the lake would recover on its own in less than 60 years voted "for" the program (see column 3 in Table 6.7). Sixty-six point seven percent of respondents who thought the lake would recover on its own in about 60 years voted "for" the program. And 72.6% of respondents who thought the lake would recover on its own more slowly voted "for" the program. The relation between beliefs about lake recovery time and votes is statistically significant [$F(2.60, 176.93) = 28.84$, $p < 0.001$].

Table 6.7. Lake recovery time

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
Less time	31.4%	41.6% (338)
About 60 years	38.6%	66.7% (418)
More time	25.1%	72.6% (276)
Don't know/refused	4.9%	27.6% (61)
Total	100.0%	

6.3.3 Program implementation without the ban

Respondents were asked, "When you decided how to vote, did you think that alum treatments would be done only if a court bans spreading of litter, or did you think that the alum treatments might be done anyway?" (Q27) Twenty-four point zero percent of people thought the alum treatments would be done even if a court does not ban spreading of poultry waste (see column 2 of Table 6.8). Seventy-three point one percent thought the alum treatments would be done only if the court first banned spreading of poultry waste.

As expected, respondents who thought the alum treatments would be done only if a court first banned spreading of poultry waste were more likely to vote "for" the program. Sixty-four point one percent of respondents who thought alum treatments would be done only if there was a ban in place voted "for" the program, whereas only 44.4% of respondents who thought alum treatments would be done without the ban voted "for" the program (see column 3 in Table 6.8). The relation between beliefs about the court ordered ban and votes "for" the program is statistically significant [$F(1.89, 128.51) = 20.18$, $p < 0.001$].

Table 6.8. Implementing program with or without the ban

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
Might be done without the ban	24.0%	44.4% (276)
Will only be done with ban	73.1%	64.1% (781)
Don't know/refused	2.9%	30.5% (36)
Total	100.0%	

6.3.4 The tax amount to be paid

Respondents were asked about how much money they expected to pay in extra taxes for the alum treatment program (Q32).

> "When you decided how to vote, did you think that if the alum treatments are done, your household would have to pay the amount I told you, more than that amount, or less than that amount?"

Thirteen point nine percent of people responded that they thought they would have to pay less money (see column 2 of Table 6.9). Fifty-one point zero percent of people thought they would have to pay the same amount, and 31.5% thought they would have to pay more money.

As expected, people who thought they would have to pay more than the amount stated were less likely to vote "for" the program. Sixty-six point five percent of people who thought they would have to the pay the amount stated voted "for" the program, and only 48.1% of people who thought they would have to pay more money voted "for" the program. Fifty-six point four percent of people who thought they would pay less money than stated voted "for" the program (see column 3 in Table 6.9). The relationship between beliefs about the tax amount and votes is statistically significant [$F(2.86, 194.29) = 11.02$, $p < 0.001$].

Table 6.9. Belief about how much the tax will be

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
Less than the amount	13.9%	56.4% (170)
The amount you told me	51.0%	66.5% (541)
More than the amount	31.5%	48.1% (339)
Don't know/refused	3.6%	40.5% (43)
Total	100.0%	

6.3.5 Conclusion

Results of the analyses presented in this section showed that most respondents accepted the main aspects of the scenario. When respondents rejected the scenario, they tended to do so in a conservative direction, suggesting the value of the program was lessened for them and increasing the likelihood they would vote “against” the program. This relationship is formalized in Section 6.5.

6.4 Construct Validity

This section evaluates variables that potentially influence respondents' votes. These variables fall into three categories: respondent characteristics, respondents' judgments about the seriousness of the problem, and respondents' judgments about feeling pushed by the interviewer. A multivariate analysis was done to explore the relationships between these variables and votes cast and the results are presented in the following section.

6.4.1 Respondent characteristics

Income

Respondents were asked, "During 2007, what was your total family income before taxes?" (Q53) Respondents who declined to answer were asked follow-up questions to place their income into a bracketed range. When respondents declined to answer both the initial and follow-up income questions, their incomes were imputed by a hot deck method (see Appendix F for details).

Table 6.10 presents the results by income percentiles. Ten point zero percent of respondents have total family incomes less than $10,000; 15.0% have incomes between $10,000 and $20,000; 25.0% have incomes between $20,000 and $37,000; 25.0% have incomes between $37,000 and $60,000; 15.0% have incomes between $60,000 and $90,000; and 10.0% have incomes larger than $90,001.

Table 6.10. Respondent income

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
<$10,000	10.0%	46.6% (142)
$10,001–$20,000	15.0%	57.2% (198)
$20,001–$37,000	25.0%	61.4% (258)
$37,001–$60,000	25.0%	59.1% (264)
$60,001–$90,000	15.0%	58.9% (129)
$90,001–$600,001	10.0%	62.3% (89)

Voting "for" the program is lowest among respondents with the lowest family incomes (less than $10,000) and for whom any extra taxes would be the greatest hardship (48.6% — see column 3 of Table 6.10). Fifty-seven point two percent with a reported income between $10,000 and $20,000 voted "for" the program, 61.4% with a reported income between $20,000 and $37,000

voted "for" the program, and 59.1% with a reported income between $37,000 and $60,000 voted "for" the program. Fifty-eight point nine percent with a reported income between $60,000 and $90,000 voted "for" the program. Sixty-two point three percent with a reported income larger than $90,000 voted "for" the program. The proportion of people in the lowest income group voting "for" the program is not significantly lower than the proportion voting "for" the program among all the higher income groups combined [$F(4.22, 287.06) = 0.67$, $p = 0.618$].

Being an environmentalist

Respondents were asked, "Would you say you think of yourself as a very strong environmentalist, a strong environmentalist, a moderate environmentalist, slightly an environmentalist, or not an environmentalist at all?" (Q41) Eight point zero percent of respondents considered themselves to be "not an environmentalist at all." Twenty-four point zero percent said they were "slightly an environmentalist," 43.5% said they were "a moderate environmentalist," 16.2% said they were "a strong environmentalist," and 7.7% said they were "a very strong environmentalist" (see column 2 in Table 6.11).

As expected, there was a direct correlation between perceived personal environmentalism and voting; 62.6% of very strong environmentalists voted "for" the program, whereas 47.9% who were not environmentalists at all voted "for" the program (see column 3 in Table 6.11). Seventy-three point two percent of strong environmentalists voted "for" the program, 59.0% of moderate environmentalists voted "for" the program, and 49.1% of respondents who answered "slightly an environmentalist" voted "for" the program. The relation between the degree to which respondents consider themselves environmentalists and votes is statistically significant [$F(4.61, 313.78) = 4.41$, $p < 0.001$].

Table 6.11. Environmentalist

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
Not an environmentalist at all	8.0%	47.9% (90)
Slightly an environmentalist	24.0%	49.1% (255)
A moderate environmentalist	43.5%	59.0% (472)
A strong environmentalist	16.2%	73.2% (185)
A very strong environmentalist	7.7%	62.6% (84)
Don't know/refused	0.6%	68.0% (7)
Total	100.0%	

6.4.2 Judgments about the seriousness of the problem

Support for spending to clean up pollution

Respondents were asked, "Should the state spend more money, less money, or about what is being spent on cleaning up pollution?" (Q11) One point nine percent of respondents thought the state should spend a lot less money, 2.2% thought the state should spend a little less money, 27.3% thought the state should spend about what is being spent now, 26.9% thought the state should spend a little more money, and 39.2% thought the state should spend a lot more money to clean up pollution (see column 2 in Table 6.12).

As expected, the more money a respondent felt the state should spend on cleaning up pollution, the more likely he or she was to vote "for" the program. Respondents who thought the state should spend more were more likely to vote "for" the program than those who thought the State should spend "about what is being spent now" – only 44 individuals thought the State should spend less (see column 3 in Table 6.12). The relationship between the amount of money respondents think the state should spend to clean up pollution and votes is statistically significant [$F(4.33, 294.56) = 4.84$, $p < 0.001$].

Table 6.12. State spending on cleaning up pollution

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
A lot less	1.9%	28.4% (18)
A little less	2.2%	62.5% (26)
About what is being spent now	27.3%	48.4% (295)
A little more	26.9%	59.7% (290)
A lot more	39.2%	66.9% (435)
Don't know/refused	2.5%	39.1% (29)
Total	100.0%	

6.4.3 State income taxes reduction

Respondents were asked, "How important to you is reducing state income taxes?" (Q6) Six point two percent of respondents thought reducing state income taxes was "not important at all." Eleven point five percent thought it was "slightly important," 24.2% thought it was "moderately important," 32.0% thought it was "very important," and 25.0% thought it was "extremely important (see column 2 in Table 6.13)."

The degree to which respondents felt that reducing state income taxes was important is unrelated to voting "for" the program. For example, 61.7% of people who answered "not at all" voted "for" the program, and 60.5% of people who answered "extremely important" voted "for" the program (see column 3 in Table 6.13). The relationship between the importance of reducing state income taxes and voting is not statistically significant [F(3.97, 269.72) = 1.73, p = 0.144].

Table 6.13. Reducing state income taxes

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
Not important at all	6.2%	61.7% (72)
Slightly important	11.5%	69.2% (123)
Moderately important	24.2%	56.1% (248)
Very important	32.0%	54.2% (359)
Extremely important	25.0%	60.5% (276)
Don't know/refused	1.0%	51.9% (15)
Total	100.0%	

6.4.4 Trust in university scientists

Respondents were asked, "In general, how much do you believe what university scientists say?" (Q35) One point six percent of respondents answered "not at all." Eleven point five percent said "a little," 34.3% said "a moderate amount," 31.4% said "a lot," and 19.9% said "a great deal" (see column 2 in Table 6.14).

As expected, the more a respondent trusted what university scientists said, the more likely he or she was to vote "for" the program. For example, whereas 78.5% of people who answered "a great deal" voted "for" the program, 22.3% of people who answered "not at all" voted "for" the program (see column 3 in Table 6.14). The relation between the amount of trust people had in what university scientists said and votes is statistically significant [F(4.42, 300.57) = 17.63, p < 0.001].

Table 6.14. Belief in what university scientists say

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
Not at all	1.6%	22.3% (19)
A little	11.5%	38.3% (119)
A moderate amount	34.3%	47.2% (370)
A lot	31.4%	67.5% (347)
A great deal	19.9%	78.5% (220)
Don't know/refused	1.3%	46.8% (18)
Total	100.0%	

6.4.5 Trust in the Oklahoma state government

Respondents were asked, "In general, how much do you believe what the people who run Oklahoma state government say?" (Q36) Nine point two percent of people answered "not at all" and 31.3% answered "a little." Another 44.4% answered "a moderate amount," 10.2% answered "a lot," and 4.7% answered "a great deal" (see column 2 in Table 6.15).

People who trusted what the Oklahoma state government said were more likely to vote "for" the program. Whereas 59.9% of people who answered "a great deal" voted "for" the program, 35.5% of people who answered "not at all" voted "for" the program (see column 3 in Table 6.15). The relation between the amount of trust people had in what the Oklahoma state government said and votes is statistically significant [$F(4.08, 277.19) = 10.05$, $p < 0.001$].

Table 6.15. Belief in what the people who run Oklahoma state government say

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
Not at all	9.2%	35.5% (105)
A little	31.3%	52% (347)
A moderate amount	44.4%	63.1% (471)
A lot	10.2%	77.1% (111)
A great deal	4.7%	59.9% (53)
Don't know/refused	0.2%	72.3% (6)
Total	100.0%	

6.4.6 Preferred payment method for new environmental programs

Respondents were asked, "If you had to choose, would you prefer to pay for new environmental programs through higher income taxes or thorough higher prices?" (Q37) Forty-five point nine percent of people preferred to pay through higher income taxes, and 33.4% preferred to pay through higher prices. Another 18.1% of people did not express a preference (see column 2 in Table 6.16).

Table 6.16. Preferred payment method for new environmental programs

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
Through higher income taxes	45.9%	74.3% (510)
Through higher prices	33.4%	44.2% (350)
No preference	18.1%	45.7% (205)
Don't know/refused	2.5%	48.6% (28)
Total	100.0%	

As expected, people who preferred to pay for new environmental programs through higher income taxes were more likely to vote "for" the program. Whereas 74.3% of people who preferred to pay through higher income taxes voted "for" the program, 44.2% of people who

preferred to pay through higher prices voted "for" the program (see column 3 in Table 6.16). The relation between preferred payment method and votes is statistically significant [F(2.93, 199.52) = 29.36, p < 0.001].

6.4.7 Proximity to the site

Among respondents, the median distance from the site was 118.2 miles. Fifty point one percent of respondents lived less than 118.2 miles away from the Illinois River, and 49.9% lived 118.2 or more miles away (see column 2 of Table 6.17). Respondents who lived further than the median distance were not significantly more likely to vote "for" the program [F(1, 68) = 1.30, p = 0.258].

Table 6.17. Distance to site

Distance	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
< 118.2 miles	50.1%	60.4% (596)
> = 118.2 miles	49.9%	56.4% (497)
Total	100%	

6.4.8 Use of a river or lake for recreation

Respondents were asked, "During the last 12 months, how many times have you gone to any river or lake for sightseeing, fishing, boating, swimming, or any other type of recreation?" (Q38) Twenty five point zero percent of respondents said they had not gone to any river or lake for recreation, and another 25.0% of people said they had gone 1 or 2 times. Twenty-five point zero percent responded with between 3 and 10 times. Fifteen point zero percent said between 11 and 300 times, while 10.0% responded with between 31 and 400 times (see column 2 in Table 6.18). Eighty-one point zero percent said 14.5 times (the mean of the distribution) or fewer times. The relationship between the number of times a respondent recreated at a river or lake and their vote is statistically significant [F(2.71, 184.06) = 2.29, p = 0.086].

Respondents who had visited any river or lake at least a few times in the previous year were more likely to vote "for" the program. Only 53.7% of respondents who visited once or twice voted "for" the program, whereas those who had visited 3–10 times voted "for" it 62.4% of the time. Those who visited at least three times voted "for" the program significantly less often: 62.4% of the time, whereas those who visited two or fewer times voted "for" the program 54.5% of the time [F(1, 68) = 5.03, p = 0.028].

Table 6.18. Recreation at a river or lake in last 12 months

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
0 times	25.0%	55.1% (364)
1–2 times	25.0%	53.7% (205)
3–10 times	25.0%	62.4% (278)
11–30 times	15.0%	66.5% (146)
31–400 times	10.0%	56.3% (100)
Total	100.0%	

6.4.9 Paid State taxes in 2007

Respondents were asked two questions pertaining to whether they paid state income taxes in 2007. The first asked, " Did anyone in your household pay Oklahoma state income taxes in 2007, either by having taxes withheld from your income or by sending money to the State with a tax form, or did no one in your household pay taxes last year?" (Q48) Respondents who answered yes to Q48 were then asked, "When you filed your state tax return for 2007, did you get a refund of all the money that you paid in before that?" (Q49) Thirty-five point four percent of respondents either did not pay 2007 taxes or were refunded all the taxes they paid.

Table 6.19. Payment of taxes in 2007

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
Paid taxes in 2007	64.6%	58.4% (661)
Did not pay taxes in 2007	35.4%	58.5% (432)
Total	100.0%	

Tax payment status is not significantly related to voting behavior, with 58.5% of those who did not pay taxes in 2007 voting "for" the program versus 58.4% of respondents who did pay taxes [$F(1, 68) = 0.00$, $p = 0.968$].

6.4.10 Difficulty paying

Respondents were asked, "How difficult would it be for your household to actually pay the additional tax of $ (BIDAMT)? Would it be extremely difficult, very difficult, moderately difficult, slightly difficult, or not difficult at all?" (Q54)

Eleven point five percent said it would be extremely difficult, 11.3% said it would be very difficult, 18.1% said it would be moderately difficult, 19.5% said it would be slightly difficult, and 39.1% said it would not be difficult at all (see column 2 of Table 6.20). As expected, the more difficult the respondent said it would be for his/her household to pay the cost of the program, the less likely he/she was to vote "for" it. Of the respondents who said it would be extremely difficult, 20.4% voted "for" the program. Of the respondents who said it would be very difficult, 36.1% voted "for" the program. Of the respondents who said it would be moderately difficult, 57.6% voted "for" the program. Of the respondents who said it would be slightly difficult to pay, 64.6% voted "for" the program. And of the respondents who said it would not be difficult at all to pay, 73.7% voted "for" the program (see column 3 of Table 6.20). The relation between difficulty to pay the tax and votes is statistically significant [$F(4.29, 291.9) = 29.9$, $p < 0.001$].

Table 6.20. Difficulty to pay tax

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
Not difficult at all	39.1%	73.7% (400)
Slightly difficult	19.5%	64.6% (221)
Moderately difficult	18.1%	57.6% (201)
Very difficult	11.3%	36.1% (127)
Extremely difficult	11.5%	20.4% (137)
Don't know/refused	0.4%	26.5% (7)
Total	100.0%	

Table 6.21 presents an ordered-logit model showing how respondent income and program cost affect the respondent's expressed difficulty of paying. The difficulty variable was re-coded (extremely difficult =5, very difficult = 4, moderately difficult = 3, slightly difficult = 2, not difficult at all = 1) so that it increases in difficulty.

As the cost increases, reported difficulty increases ($b = 0.006$, $p < 0.001$). As income increases, difficulty decreases ($b = -0.000023$, $p < 0.001$). The coefficients were jointly significant: $F(2,67) = 68.33$, $p < 0.001$.

Table 6.21. Ordered logit regression predicting difficulty of paying the cost of the program

Variable	Coefficient	Jackknife Standard error	t	p-value	95% confidence interval	
Income	-0.000023	0.000	-7.18	0.000	-0.000	-0.000
Cost	0.006	0.001	11.43	0.000	0.005	0.007
Cutpoint 1	-0.654	0.149	-4.38	0.000	-0.952	-0.356
Cutpoint 2	0.331	0.135	2.45	0.017	0.061	0.601
Cutpoint 3	1.36	0.149	9.16	0.000	1.066	1.66
Cutpoint 4	2.307	0.195	11.80	0.000	1.917	2.697

6.4.11 Judgments of the damage and the program

Seriousness of the damage to the river

Respondents were asked, "After spreading of litter is banned, how serious did you think the effects of algae in the river would be if no alum treatments are done?" (Q25) Five point three percent of respondents answered "not serious at all," and 13.0% answered "slightly serious." Thirty-seven point four percent answered "moderately serious," 30.3% answered "very serious," and 12.3% answered "extremely serious" (see column 2 in Table 6.22).

Table 6.22. Seriousness of algae effects in river without alum

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
Not serious at all	5.3%	23.9% (55)
Slightly serious	13.0%	23.0% (142)
Moderately serious	37.4%	55.5% (388)
Very serious	30.3%	72.3% (339)
Extremely serious	12.3%	90.2% (145)
Don't know/refused	1.6%	22.7% (24)
Total	100.0%	

As expected, the more serious respondents thought the problem was in the river, the more likely they were to vote "for" the program. For example, whereas 90.2% of people thought the problem was "extremely serious" and voted "for" the program, 72.3% who thought it was "very serious" voted "for" the program, while smaller proportions of people who thought it was less serious

voted "for" it (see column 3 in Table 6.22). The relation between perceived seriousness of the river's condition without alum treatments and votes is statistically significant [$F(4.63, 314.79) = 29.83$, $p < 0.001$].

Seriousness of the damage to the lake

Respondents were asked, "After spreading of litter is banned, how serious did you think the effects of algae in the lake would be if no alum treatments are done?" (Q26) Five point six percent of respondents answered "not serious at all" and 14.9% percent answered "slightly serious." Thirty-three point four percent answered "moderately serious," 31.7% answered "very serious," and 13.2% answered "extremely serious (see column 2 in Table 6.23)."

As expected, the more serious respondents thought the problem would be in the lake, the more likely they were to vote "for" the program. Whereas 83.7% of people thought the problem was "extremely serious" and voted "for" the program, 77.7% who thought it was "very serious" voted "for" the program, and smaller proportions of people who thought it was less serious voted "for" it (see column 3 in Table 6.23). The relation between beliefs about the seriousness of the lake's condition without alum treatments and votes is statistically significant [$F(4.58, 311.78) = 35.45$, $p < 0.001$].

Table 6.23. Seriousness of algae effects in lake without alum

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
Not serious at all	5.6%	19.3% (59)
Slightly serious	14.9%	21% (162)
Moderately serious	33.4%	54.3% (349)
Very serious	31.7%	77.7% (349)
Extremely serious	13.2%	83.7% (154)
Don't know/refused	1.2%	29.2% (20)
Total	100.0%	

Increasing chances of cleaning up other water bodies

Respondents were asked, "When you decided how to vote, did you think that if the alum treatments are done successfully for the Illinois River and Tenkiller Lake, this would or would not increase the chances that other rivers and lakes in Oklahoma would get alum treatments later?" (Q34) Nine point two percent of people thought it would not increase the chances.

Eighty-seven point nine percent thought it would increase the chances (see column 2 in Table 6.24).

Of the respondents who thought the chances that other rivers and lakes would get alum treatments would not be increased, 31.4% voted "for" the program. Of the respondents who thought the chance that other rivers and lakes would get alum treatments would be increased, 61.8% voted "for" the program. The relation between beliefs about other rivers and lakes in Oklahoma getting alum treatments and votes is statistically significant [$F(1.99, 135.11) = 17.08$, $p < 0.001$].

Table 6.24. Successful alum treatments for the Illinois River and Tenkiller Lake would or would not increase the chances that other rivers and lakes get alum treatments later

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
Would not	9.2%	31.4% (104)
Would	87.9%	61.8% (956)
Don't know/refused	2.8%	41.5% (33)
Total	100.0%	

6.4.12 Judgments about the interview

Feeling pushed

Near the end of the interview, respondents were asked, "Thinking about all the information I gave you, overall, did it try to push you to vote one way or the other, or did it let you make up your own mind about which way to vote?" (Q56) Respondents who said they felt pushed where then asked, "Which way did it try to push you to vote?" (Q56a) Ninety point two percent of respondents said the information let them make up their own mind (see column 2 of Table 6.25). Eight point nine percent of respondents felt pushed to vote "for" the program, and 0.5% of respondents felt pushed to vote "against" the program. No significant relationship was found between feeling pushed to vote either way and votes [$F(2.98, 202.34) = 0.98$, $p = 0.404$].

Table 6.25. Pushed to vote a particular way

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
Pushed to vote against	0.5%	38.4% (4)
Let me make up my own mind	90.2%	59.1% (994)
Pushed to vote "for"	8.9%	53.7% (88)
Other	0.3%	33.0% (4)
Don't know/refused	0.1%	0.0% (3)
Total	100.0%	

6.5 Construct Validity Regression Predicting Voting in Favor

This section uses a logit model to combine the variables considered individually in sections 6.3 and 6.4 to gauge their collective effect on voting decisions. The variables and our expectations of effect are defined as follows:

- **Cost**: The cost of the program to the respondent's household, coded in dollars. We expect that respondents would be less likely to vote "for" the program as the cost of the treatment increased.

- **Income**: The respondent's 2007 household income, coded in dollars, log transformed. Respondents with higher incomes are more likely to be able to pay for the cost of the program and therefore we expect them to be more inclined to vote "for" the program.

- **Frequency of visiting a river or lake for recreation**: Coded 1 if 6 or more times in the last year and coded 0 for all other respondents. People who use rivers or lakes more often for recreation (i.e., have a high *use value*) are expected to be more willing to vote "for" the program

- **Distance from the respondent's home to the river/lake**: Coded 1 for respondents who lived more than 118.2 miles away (the median distance) and coded 0 for all other respondents. We expect that people who live farther from the river/lake would be less likely to vote "for" the program because they might see less personal benefits to it or might be more interested in rivers or lakes closer to where they live.

- **Seriousness of the problem**: Coded 1 if the respondent thought the effects of algae in the river *and* lake would be either extremely serious or very serious; coded ½ if the respondent thought the effects of algae in the river *or* lake would be either extremely serious or very serious, but not in both; coded 0 for all other respondents. Respondents who thought the problem would be more serious are expected to vote "for" the program.

- **Plan implementation without the ban**: Coded 1 if the respondent said the program might be implemented even if a ban on future spreading of litter is not implemented and coded 0 for all other respondents. We expect people who thought the plan might be implemented without a ban on future spreading to be less inclined to vote "for" the program.

- **Natural recovery: slower than stated**: Coded 1 if the respondent said that the river *and* lake would recover on their own more slowly than stated in the scenario; coded ½ if the respondent said that the river *or* lake would recover on their own more slowly than stated in the scenario, but not both; coded 0 for all other respondents. People who thought natural recovery would be slower than was described are expected to be more inclined to vote "for" the program.

- **Natural recovery: faster than stated**: Coded 1 if the respondent said that the river *and* lake would recover on their own faster than stated in the scenario; coded ½ if the

respondent said that the river *or* lake would recover on their own more faster than stated in the scenario, but not both; coded 0 for all other respondents. We expect people who thought natural recovery would be faster than was described to be less inclined to vote "for" the program.

- **Effectiveness of the program**: Coded 1 for respondents who thought the alum treatments would work slightly well or not well at all and coded 0 for all other respondents. We expect respondents who thought the treatments would be less effective to be less inclined to vote "for" the program.

- **Actual program cost would exceed the stated cost**: Coded 1 for respondents who thought they would pay more than the stated cost if the program is implemented and coded 0 for all other respondents. Respondents who thought the actual program cost would exceed the stated cost are expected to be less inclined to vote "for" the program.

- **Tax would be used to clean other rivers/lakes**: Coded 1 for respondents who thought the tax would be used to clean up other rivers and lakes in Oklahoma in addition to Tenkiller Lake, the Illinois River, and creeks flowing into it and coded 0 for all other respondents. We expect respondents who thought the tax funds would be used to clear up other rivers or lakes would be more inclined to vote "for" the program.

- **Trust in scientists and the Oklahoma government**: Coded 1 for respondents who believed what university scientists *and* the Oklahoma government say a lot or a great deal; coded ½ for respondents who believed what university scientists *or* the Oklahoma government say a lot or a great deal, but not both; coded 0 for all other respondents. Respondents who did not trust scientists or the Oklahoma government are expected to be less inclined to vote "for" the program.

- **Preferred method for funding environmental programs**: Coded 1 for respondents who preferred paying for new environmental programs through higher income taxes and coded 0 for all other respondents. We expect respondents who preferred to pay for new environmental programs via taxes would be more willing to vote "for" this program, which entailed that funding mechanism.

- **Environmentalist**: Coded 1 for all respondents who thought of themselves as strong environmentalists or very strong environmentalists and coded 0 for all other respondents. People who thought of themselves as environmentalists are expected to be more inclined to vote "for" the program.

- **Felt pushed to vote "for" the program**: Coded 1 for respondents who felt pushed to vote "for" the program and 0 for all other respondents. People who felt pushed to vote "for" the program are expected to be more likely to do so as a result.

- **Paid Oklahoma state taxes in 2007**: Coded 1 for respondents who did not pay Oklahoma state income tax in 2007 or got all their payments back in a refund, and coded 0 for all other respondents. We suspected that people who did not pay Oklahoma state

taxes in 2007 might think that they would not have to pay the special tax for the alum program and might therefore choose to "free ride" by voting "for" the program and hoping to enjoy its benefits without having to pay for its costs.

- **Importance of reducing state income taxes**: Coded 1 for respondents who said that reducing state income taxes was very important or extremely important to them personally and coded 0 for all other respondents. We expect people who placed importance on reducing state income taxes to be more likely to vote "against" the program, since it would entail increasing state income taxes.

- **Support for more government spending to clean up pollution**: Coded 1 for respondents who believes that the State of Oklahoma should spend more money cleaning up pollution and coded 0 for all other respondents. We expect an increased likelihood of voting "for" the program among people who supported more government spending on pollution cleanup.

As shown in Table 6.26, the logistic regression results generally confirmed our expectations:

- **Cost**: As the cost of the program increased, voting "for" the program decreased ($b = -0.006$, $p < 0.001$).

- **Income**: As the log of household income increased, voting "for" the program increased ($b = 0.311$, $p < 0.002$).

- **Frequency of visiting a river or lake for recreation**: Respondents who visited the lake or river six or more time were significantly more likely to vote "for" the program ($b = 0.524$, $p < 0.009$).

- **Distance from the respondent's home to the river/lake**: Voting "for" the program did not vary significantly with distance from the river/lake ($b = -0.033$, $p = 0.849$).

- **Seriousness of the problem**: Those who felt the problem was serious were more likely to vote "for" the program ($b = 1.617$, $p < 0.001$).

- **Plan implementation without the ban**: Believing the program might be implemented even if a ban on future spreading of poultry waste is not implemented yielded a reduction in voting "for" the program ($b = -0.865$ $p < 0.001$).

- **Natural recovery: slower than stated**: Believing that natural recovery of the river or lake would be slower than stated was associated with increased voting "for" the program ($b = 0.434$, $p < 0.070$).

- **Natural recovery: faster than stated**: Believing that natural recovery of the river or lake would be faster than stated was associated with decreased voting "for" the program ($b = -0.472$, $p = 0.022$).

- **Effectiveness of the program**: Believing that the program would be less effective was associated with decreased voting "for" the program ($b = -1.231$, $p < 0.001$).

- **Actual program cost would exceed the stated cost**: Those who believed the actual cost of the program would exceed the stated cost were less likely to vote "for" the program ($b = -0.508$, $p < 0.007$).

- **Tax would be used to clean other rivers/lakes**: Believing that the tax funds would be used to clean up other rivers and lakes in Oklahoma in addition to Tenkiller Lake, the Illinois River, and creeks flowing into it was associated with increased voting "for" the program ($b = 0.328$, $p = 0.040$).

- **Trust in scientists and the Oklahoma government**: Respondents who trust what university scientists or the Oklahoma government say were more likely to vote "for" the program ($b = 0.402$, $p = 0.170$).

- **Preferred method for funding environmental programs**: Preferring to pay for new environmental programs through higher income taxes was associated with increased voting "for" the program ($b = 0.893$, $p < 0.001$).

- **Environmentalist**: Respondents who believed they were a strong or very strong environmentalist tended to vote "for" the program ($b = 0.441$, $p < 0.039$).

- **Felt pushed to vote "for" the program**: Feeling pushed to vote "for" the program did not significantly affect voting ($b = 0.094$, $p = 0.773$).

- **Paid Oklahoma state taxes in 2007**: There was no significant association between not paying Oklahoma state income tax in 2007 and voting ($b = 0.186$, $p = 0.272$).

- **Importance of reducing state income taxes**: The importance for reducing state income taxes was not associated with vote choices ($b = -0.106$, $p = 0.522$).

- **Support for more government spending to clean up pollution**: Believing that state government spending on cleaning up pollution should be increased was associated with increased voting "for" the program ($b = 0.418$, $p = 0.020$).

The model was estimated for 1080 observations and produced a statistically significant set of parameter estimates. The F-test of joint significance was $F(18, 51) = 15.15$ $p < 0.001$ and the pseudo-R^2 was 0.31.

Table 6.26. Construct validity logit model

Variable	Coefficient	Jackknife Standard error	t	p-value	95% confidence interval	
Cost	-0.006	0.001	-7.25	0.000	-0.008	-0.004
Ln(Income)	0.311	0.095	3.29	0.002	0.122	0.500
Frequency of visiting a river or lake for recreation	0.524	0.194	2.71	0.009	0.138	0.910
Distance from the respondent's home to the river/lake	-0.033	0.175	-0.19	0.849	-0.384	0.317
Seriousness of the problem	1.617	0.222	7.30	0.000	1.175	2.059
Plan implementation without the ban	-0.865	0.203	-4.26	0.000	-1.27	-0.460
Natural recovery slower than stated	0.434	0.236	1.84	0.070	-0.037	0.904
Natural recovery faster than stated	-0.472	0.201	-2.35	0.022	-0.872	-0.072
Effectiveness of the program	-1.231	0.314	-3.92	0.000	-1.857	-0.605
Actual program cost would exceed the stated cost	-0.508	0.184	-2.76	0.007	-0.876	-0.14108
Tax would be used to clean other rivers/lakes	0.328	0.157	2.09	0.040	0.015	0.641
Trust in scientists and the Oklahoma government	0.402	0.290	1.39	0.170	-0.177	0.980
Preferred method for funding environmental programs	0.893	0.155	5.75	0.000	0.58352	1.20
Environmentalist	0.441	0.209	2.11	0.039	0.024	0.859
Felt pushed to vote "for" the program	0.094	0.324	0.29	0.773	-0.553	0.741
Paid Oklahoma state taxes in 2007	0.186	0.168	1.11	0.272	-0.149	0.521
Importance of reducing state income taxes	-0.106	0.164	-0.64	0.522	-0.434	0.222
Support for more government spending to clean up pollution	0.418	0.176	2.38	0.020	0.067	0.770
Constant	-3.318	1.049	-3.16	0.002	-5.411	-1.224

6.6 Tests of Scope

6.6.1 Comparing votes "for" the base and scope programs

A total of 544 survey respondents were administered the scope version of the survey. Table 6.27 compares the votes "for" the base and scope scenarios. At each cost level, respondents who received the scope scenario were less likely to vote "for" the program than were respondents who received the base scenario (see also Figure 6.2).[3] Overall, this relation was statistically significant [$F(6, 63) = 6.74$, $p < 0.001$]. A logistic regression predicting voting choices based on a binary variable contrasting the base respondents (coded 0) with the scope respondents (coded 1) estimated a coefficient that was significant and negative, as expected ($b = -0.61$, $p < 0.001$, $N = 1,637$). When cost was added to the logit model, the coefficients were both negative and significant, as expected: scope $b = -0.66$, $p < 0.001$, cost $b = -0.004$, $p < 0.000$, $N = 1,637$. An F test that corresponds to the one performed on the Base data in Section 6.1 does not reject the hypothesis that responses do not vary by cost ($F(5,64) = 7.99$, $p<.001$). The lower bound WTP estimate for the scope case is presented in Chapter 7.

Table 6.27. The proportions of respondents who voted "for" the base program, and the proportions of respondents who voted "for" the scope program

Cost	Base program (N = 1,093)	Scope program (N = 506)
$10	81.5%	70.6%
$45	70.1%	47.9%
$80	60.2%	41.4%
$125	61.5%	38.9%
$205	43.5%	31.3%
$405	34.2%	28.8%

3.Five respondents who received the scope scenario initially voted "for" the program and later changed to vote "against" it. The reasons these respondents gave for voting "against" focused on the financial burden of paying for the program.

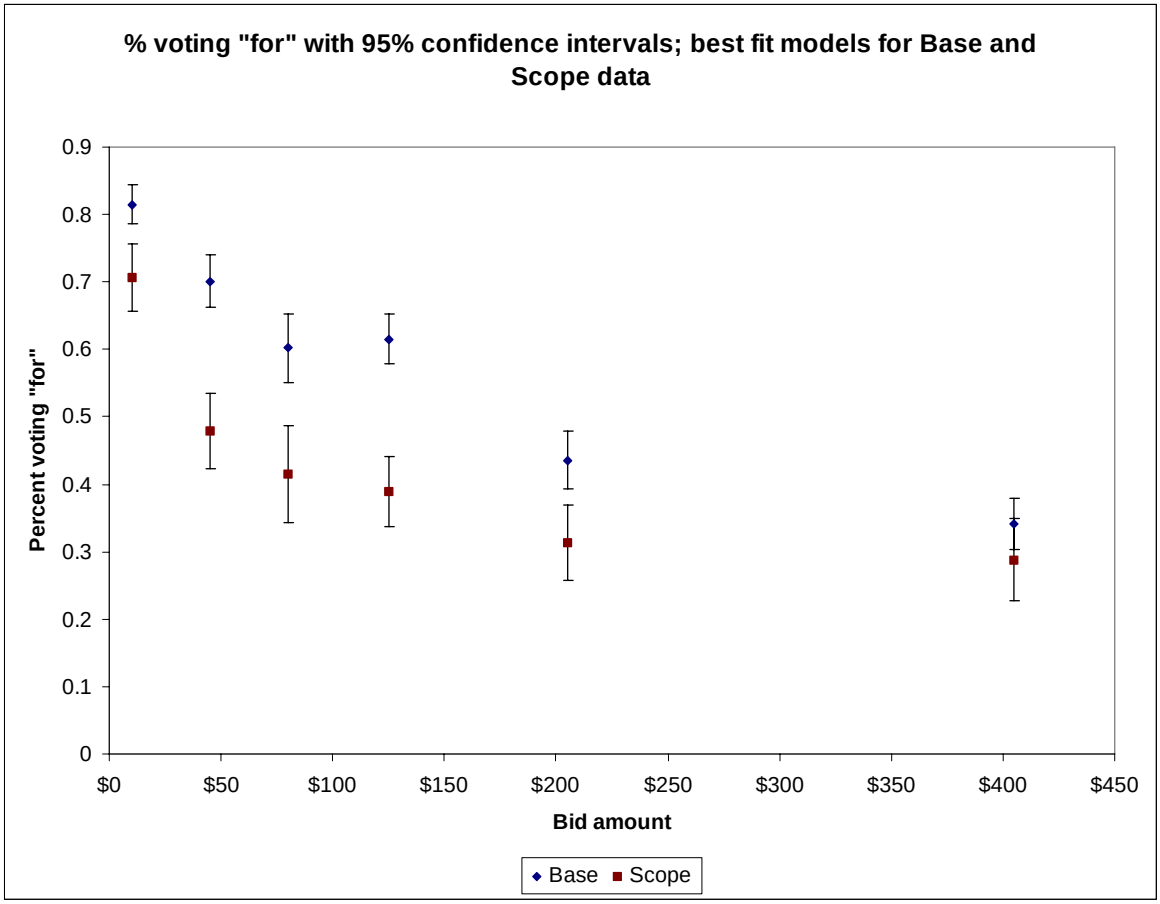

Figure 6.2. Comparison of % voting "for" in base and scope votes.

6.6.2 Reasons for votes by the scope respondents

As Tables 6.28 through 6.30 illustrate, the reasons given by the scope respondents for voting "for" and "against" the program and for not knowing how they wanted to vote closely resemble the reasons given by the base respondents.

Table 6.28. Reasons for voting "against" the program (Scope)

Coding category	% of respondents [a] (N = 297)
Program does not do enough	18.5%
Let nature solve the problem	12.0%
Other issues are more important	11.8%
Benefits are not worth cost	8.5%
Cost is too high for Respondent/Household	8.3%
Cost of program is too high	6.5%
Other	5.3%
Does not care about the problem	4.8%
Problem could/should be solved other ways	3.8%
Program only helps a few rivers and/or lakes	3.5%
Does not want to pay more taxes	3.3%
Polluters should pay	2.8%
Cost too high for others	2.5%
Treatments could have unknown bad effects	2.3%
Not sure if the program would work	1.8%
Someone else should pay	1.5%
Does not like way payment would be collected	1.0%
Money might be used for other purposes	1.0%
Users should pay	0.5%
Program would be done for other rivers/lakes	0.3%
Does not trust government	0.3%
Don't know/ Doesn't remember	0.3%

a. Percentages can add up to more than 100% because individuals could provide more than one reason

Table 6.29. Reasons for "don't know" response (Scope)

Coding category	% of respondents[a] (N = 7)
Refused	25.0%
Cost is too high for Respondent/Household	12.5%
Benefits are not worth cost	12.5%
Not sure if the program would work	12.5%
Other issues are more important	12.5%
Other	12.5%
Treatments could have unknown bad effects	12.5%

a. Percentages can add up to more than 100% because individuals could provide more than one reason

Table 6.30. Reasons for voting "for" the program (Scope)

Coding category	% of respondents[a] (N = 240)
Program will help area around river and lake	34.1%
Program will benefit others	16.6%
Program will speed up the recovery	15.9%
Other	7.8%
Program will bring lake back to earlier state	6.8%
Program reduces risk to human health	5.1%
Program will protect environment in general	4.7%
Respondent would benefit from program	3.7%
Respondent is concerned about environment	2.7%
Society is responsible for fixing problem	1.0%
Program has other benefits than cleaning water	1.0%
Others in household concerned about environment	0.3%
Blank response	0.3%

a. Percentages can add up to more than 100% because individuals could provide more than one reason

6.7 Sensitivity Analysis

This section examines how the percent voting "for" the program varies as a function of three things: respondent certainty, respondent acceptance of the scenario, and interviewer evaluation of respondents' attentiveness and understanding of the material. In Section 6.7.2, a model is presented that adjusts for the fact that not all respondents expressed certainty about their votes or embraced all aspects of the scenario. The WTP estimate based on this model is presented in Appendix G, along with two other WTP estimates that are generated based on data presented in sections 6.7.1 and 6.7.3. The results support the robustness of the WTP estimate presented in Chapter 7.

6.7.1 Certainty

After respondents voted, they were asked how sure they were that they wanted to vote "for" or "against" the program (Q24). As shown in the column 2 of Table 6.31, 32.5% said they were extremely sure, 39.1% said they were very sure, 20.3% said they were moderately sure, 5.6% said they were slightly sure, and 2.3% said they were not sure at all.

As certainty decreased, the likelihood of voting "for" the program decreased as well, as shown in the second column of Table 6.31. Fifty-nine point zero percent, 62.4%, and 64.2% of people who were extremely sure, very sure, and moderately sure, respectively, voted "for" the program. In contrast, 31.2% and 30.4% of respondents who were slightly sure and not sure at all, respectively, voted "for" the program [$F(4.39, 298.39) = 6.12$, $p < 0.001$].

Table 6.31. Vote certainty

Response	% of the sample (N = 1076)	% of respondents voting "for" (base unweighted N)
Not sure at all	2.3%	30.4% (29)
Slightly sure	5.6%	31.2% (56)
Moderately sure	20.3%	64.2% (206)
Very sure	39.1%	62.4% (426)
Extremely sure	32.5%	59.0% (358)
Don't know/refused	0.1%	0.0% (1)
Total	100.0%	

6.7.2 Adjustments to votes "for" scenario acceptance and uncertainty

Section 6.3 examined the relationships between scenario acceptance and voting. It was found that votes varied significantly with the various aspects of scenario acceptance. In most cases, rejection of the scenario led to more conservative votes. In Section 6.7.1, it was found that votes were also significantly related to certainty. The survey data permit a statistical investigation that gauges how people's voting decisions might have changed had they accepted all aspects of the scenario and been more certain. For this purpose, the following conditions were investigated:

- **Plan implementation without the ban**: No respondents believed that the program might be carried out even if a ban on future spreading of litter is not implemented.
- **Natural recovery**: All respondents believed that natural recovery of the river and lake would take the amounts of time stated in the scenario.
- **Effectiveness of the program**: All respondents believed that the program would be at least moderately effective.
- **Actual program cost of the program**: All respondents believed that the actual cost of the program matched the stated cost.
- **Tax used to clean other rivers/lakes**: All respondents believed that the tax funds would not be used to clean up other rivers and lakes in Oklahoma in addition to Tenkiller Lake, the Illinois River, and creeks flowing into it.
- **Certainty**: All respondents were at least moderately sure of their vote choice.

A logistic regression equation was estimated to predict vote choices using the full array of predictors presented in section 6.5 plus the certainty variable. The resulting parameter estimates appear in Table 6.32.[4] N = 1,080. An F-test of joint significance finds that the parameter estimate vector is statistically different from zero [$F(19, 50) = 20.49$, $p < 0.001$] and the pseudo-R^2 is 0.33. The regression equation was used to predict each respondent's probability of voting "for" the program substituting the values of the predictors listed above and the actual values of the remaining predictors in the equation. This probability is contrasted with the predicted probability of voting "for" the program using each respondent's actual values for all predictors in the equation.

4 To the degree that the respondent's judgments regarding the effectiveness and other aspects of the program were made concurrently with the decision on the vote, the coefficients and their standard error may be affected.

Table 6.32. Vote adjustment logit model

Variable	Coefficient	Jackknife Standard error	T	p-value	95% confidence interval	
Cost	-0.006	0.001	-7.14	0.000	-0.008	-0.004
Ln(Income)	0.305	0.096	3.18	0.002	0.113	0.496
Frequency of visiting a river or lake for recreation	0.472	0.197	2.39	0.019	0.078	0.866
Distance from the respondent's home to the river/lake	-0.071	0.174	-0.41	0.686	-0.418	0.277
Seriousness of the problem	1.603	0.233	6.89	0.000	1.139	2.067
Plan implementation without the ban	-0.792	0.212	-3.74	0.000	-1.215	-0.369
Natural recovery slower than stated	0.536	0.259	2.07	0.042	-0.019	1.053
Natural recovery faster than stated	-0.462	0.198	-2.34	0.022	-0.856	-0.067
Effectiveness of the program	-1.230	0.349	-3.52	0.001	-1.927	-0.534
Actual program cost would exceed the stated cost	-0.482	0.192	-2.51	0.014	-0.865	-0.099
Tax would be used to clean other rivers/lakes	0.319	0.163	1.96	0.054	-0.006	0.644
Trust in scientists and the Oklahoma government	0.328	0.304	1.08	0.284	-0.278	0.935
Preferred method for funding environmental programs	0.873	0.172	5.09	0.000	0.531	1.22
Environmentalist	0.522	0.232	2.25	0.028	0.060	0.984
Felt pushed to vote "for" the program	0.076	0.343	0.22	0.825	-0.609	0.761
Paid Oklahoma state taxes in 2007	0.250	0.179	1.40	0.166	-0.106	0.606
Importance of reducing state income taxes	-0.124	0.168	-0.74	0.463	-0.460	0.212
Support for more government spending to clean up pollution	0.451	0.181	2.49	0.015	0.090	0.811
Certainty	1.515	0.427	3.55	0.001	0.663	2.37
Constant	-4.632	1.126	-4.12	0.001	-6.878	-2.386

The predicted probabilities of voting "for" the program generated using the actual values of the predictors (shown in column 1 of Table 6.33) are lower at every cost amount than the predicted probabilities generated using the mixture of actual and predicted values (shown in column 2 of Table 6.33). The last column in Table 6.33 shows the magnitude of the increase at each cost amount. This suggests that if all respondents had accepted all descriptions offered in the scenario and had made their judgments with a relatively high degree of certainty, the net effect would be to raise the probabilities of voting "for" and, therefore, the estimate of WTP (see Appendix G for the formal tests of this result).

Table 6.33. Predicted probabilities of voting "for" the program using actual versus predicted values

Cost	Predicted % of votes "for" the program with actual values of all predictors	Predicted % of votes "for" the program with predicted values	Difference
$10	74.1%	81.8%	7.7%
$45	67.9%	76.7%	8.8%
$80	64.8%	76.4%	11.6%
$125	61.2%	70.7%	9.5%
$205	54.3%	62.0%	7.7%
$405	27.7%	34.0%	6.3%

6.7.3 Interviewer assessments

After each interview, interviewers answered a series of questions about respondent attentiveness, patience, understanding and seriousness. This section examines the association between votes and interviewer assessments. Appendix G discusses how these interviewer assessments might affect the WTP estimate.

Interviewer assessment of distraction

Interviewers were asked, "How distracted was the respondent?" (D2) Seventy-two point six percent of interviewers answered "not at all," and 15.7% said "slightly." Another 7.3% said "moderately," 2.3% said "very," and 2.2% said "extremely" (see column 2 of Table 6.34).

Sixty-one point eight percent of respondents who were thought not to have been distracted at all voted "for" the program (see column 3 of Table 6.34); 48.2% of respondents who were thought to have been slightly distracted voted "for" it; and 46.5% of respondents who were thought to have been moderately distracted voted "for" it. Of the respondents who were thought to have been very and extremely distracted, 54.8% and 61.8%, respectively, voted "for" the program. The relation between interviewer's perception of how distracted the respondent was and the vote is statistically significant [$F(3.67, 249.32) = 3.21$, $p = 0.016$].

Table 6.34. How distracted was the respondent?

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
Not distracted at all	72.6%	61.8% (783)
Slightly distracted	15.7%	48.2% (173)
Moderately distracted	7.3%	46.5% (91)
Very distracted	2.3%	54.8% (25)
Extremely distracted	2.2%	61.8% (21)
Total	100.0%	

Attentiveness

Interviewers were asked, "How attentive was the respondent?" (D3) One point six percent of interviewers responded "not at all," and 2.1% said "slightly." Another 7.6% said "moderately," 42.2% said "very," and 46.5% said "extremely" (see column 2 of Table 6.35).

Seventy point three percent of respondents who were thought to have not been attentive at all voted "for" the program (see column 3 of Table 6.35); 37.5% of respondents who were thought to have been slightly attentive voted "for" it; and 36.2% of respondents who were thought to have been moderately attentive voted "for" it. Of the respondents who were thought to have been very or extremely attentive, 56.2% and 64.6%, respectively, voted "for" the program. The relation between interviewers perception of how attentive the respondent was and the vote is statistically significant [$F(3.61, 245.39) = 7.20$, $p < 0.001$].

Table 6.35. How attentive was the respondent?

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
Not attentive at all	1.6%	70.3% (18)
Slightly attentive	2.1%	37.5% (23)
Moderately attentive	7.6%	36.2% (90)
Very attentive	42.2%	56.2% (459)
Extremely attentive	46.5%	64.6% (503)
Total	100.0%	

Impatience

Interviewers were asked, "How impatient was the respondent?" (D7) Eighty-three point nine percent of interviewers responded "not impatient at all," and 9.6% said "slightly impatient." Another 3.4% said "moderately impatient," and 1.9% said "very impatient," and 1.2% said "extremely impatient" (see column 2 of Table 6.36).

Of the respondents who were thought to have been not impatient at all, 59.0% voted "for" the program (see column 3 of Table 6.36); 51.9% of respondents who were thought to have been slightly impatient voted "for" it; and 52.5% of respondents who were thought to have been moderately impatient voted "for" it. Of the respondents who were thought to have been very or extremely impatient, 59.0% and 81.4%, respectively, voted "for" the program. The relation between interviewer perception of respondent impatience and the vote is not statistically significant [$F(3.70, 251.90) = 1.29$, $p = 0.277$].

Table 6.36. How impatient was the respondent?

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
Not impatient at all	83.9%	59.0% (890)
Slightly impatient	9.6%	51.9% (122)
Moderately impatient	3.4%	52.5% (45)
Very impatient	1.9%	59.0% (23)
Extremely impatient	1.2%	81.4% (13)
Total	100.0%	

Serious thought

Interviewers were asked, "How seriously did the respondent think about the decision about how to vote?" (D8) Four interviewers (0.3%) responded "not seriously at all," and only 1.3% said "slightly seriously." Eight percent said "moderately seriously," and 47.9% said "very seriously," and 42.6% said "extremely seriously" (see column 2 of Table 6.37).

Sixty-eight point two percent of respondents who were said not to have thought about the decision at all seriously voted "for" the program (see column 3 of Table 6.37); 30.5% of respondents who were said to have thought slightly seriously voted "for" it; and 44.3% of respondents who were said to have thought about the decision moderately seriously voted "for" it. Of the respondents who were said to have thought about the decision very or extremely seriously, 58.8% and 61.3%, respectively, voted "for" the program. The relation between

perception of how seriously the respondent thought about the decision and the vote is statistically significant [F(3.44, 233.69) = 2.96, p = 0.027].

Table 6.37. How seriously did the respondent think about the decision about how to vote?

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
Not at all seriously	0.3%	68.2% (4)
Slightly seriously	1.3%	30.5% (14)
Moderately seriously	8.0%	44.3% (87)
Very seriously	47.9%	58.8% (518)
Extremely seriously	42.6%	61.3% (470)
Total	100.0%	

Understanding of the information

Interviewers were asked, "How well did the respondent understand the material?" (D4) Two interviewers (0.2%) responded "not at all," and only 1.5% said "slightly." Nine point six percent said "moderately," 40.7% said "very," and 48% said "extremely" (see column 2 of Table 6.38).

One hundred point zero percent of respondents who were thought to have understood the material not at all voted "for" the program; 48.7% percent of respondents who were thought to have understood the material only slightly voted "for" the program (see column 3 of Table 6.38); 48.8% of respondents who were thought to have understood the material moderately well voted "for" it; and 58.2% of respondents who were thought to have understood the material very well voted "for" it. Of the respondents thought to have understood the material extremely well, 60.7% voted "for" the program. The relation between perceptions of how seriously the respondent thought about the voting decision and the vote is not statistically significant [F(3.82, 259.43) = 1.34, p = 0.257].

Table 6.38. Understand the material

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
Not at all	0.2%	100.0% (2)
Slightly	1.5%	48.7% (20)
Moderately	9.6%	48.8% (110)
Very	40.7%	58.2% (437)
Extremely	48.0%	60.7% (524)
Total	100.0%	

Respondent expressed difficulty understanding the information

Interviewers were asked, "Did the respondent say anything suggesting that he or she had any difficulty understanding what you told him or her?" (D5) Interviewers said that 97.5% of the respondents did not have difficulty understanding. Two point five percent said respondents did indicate some difficulty understanding (see column 2 in Table 6.39).

Fifty-eight point two percent of respondents who did not express difficulty understanding the material voted "for" the program, and 67.3% of respondents who expressed difficulty understanding the material voted "for" it (see column 3 of Table 6.39). The relation between expressions suggesting difficulty understanding the material and the vote is not statistically significant [$F(1, 68) = 0.76$, $p = 0.388$].

Table 6.39. Difficulty understanding what interviewer said

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
No	97.5%	58.2% (1063)
Yes	2.5%	67.3% (30)
Total	100.0%	

Understood the vote question

Interviewers were asked, "Did the respondent have any difficulty understanding the vote questions?" (D6) According to the interviewers, 98.1% of the respondents did not have difficulty understanding the vote questions. One point nine percent of respondents did have difficulty understanding those questions (see column 2 in Table 6.40).

Fifty-eight point one percent of respondents who were thought to have had no difficulty understanding the vote questions voted "for" the program, and 71.8% of respondents who were thought to have had difficulty understanding the vote questions voted "for" it (see column 3 of Table 6.40). The relation between perceptions of whether respondents had difficulty understanding the vote questions and the vote is not statistically significant [$F(1, 68) = 1.63$, $p = 0.206$].

Table 6.40. Difficulty understanding the vote questions

Response	% of the sample (N = 1,093)	% of respondents voting "for" (base unweighted N)
No	98.1%	58.1% (1,066)
Yes	1.9%	71.8% (27)
Total	100.0%	

6.8 Conclusion

Across a range of tests, voting "for" the program was found to be responsive to the cost, to a variety of respondent characteristics and judgments about the program and circumstances of the injury, and to the scope of the injury. Furthermore, respondents' stated reasons for voting "for" and "against" the program indicate consideration of factors normatively sensible for assessing the value of a public good. Taken together, these findings offer a basis for confidence in the validity of the survey's measurement of WTP.

7. Estimate of the Natural Resource Damages

Chapter 6 reported the percentage of respondents who voted "for" the alum treatment program. The alum treatment program was presented to respondents as a means of eliciting their value for accelerating the recovery of the Illinois River system and Tenkiller Lake to what they were like in around 1960. This chapter presents a conservative estimate of the value placed on injuries to Oklahoma public trust resources in the Illinois River system and Tenkiller Lake. This estimate of value applies to households in the 63 counties of the study area and is the Team's conservative estimate of the value placed by the public on an accelerated reduction in future natural resource injuries to public trust resources in the Illinois River system and Tenkiller Lake. This conservative estimate of value is the Team's measure of natural resource damages.

It is important to note that the measure of damages reported in this chapter does not include all damage categories (see Table 1.1). It does not include damages to the residents of 14 western counties (approximately 3% of the State's population), whose values for the injuries were not assessed in this study. Moreover, the damages were predicated on the assumption that the spreading of poultry waste is stopped by December 2008. If spreading of poultry litter is not stopped, then future injuries will be larger (Cooke and Welch, 2008; Stevenson, 2008) and, therefore, the natural resource damages will be higher. Furthermore, injuries to surface drinking water and groundwater and injuries associated with bacteria were not covered by this study. Finally, the estimate of damages presented here does not include past damages associated with the injuries.

7.1 Estimate of the Average Value per Household in Oklahoma for the Continuing Injuries to the Illinois River System and Tenkiller Lake

This section presents and explains an estimate of the average value placed by an Oklahoma household in the study on the prospective loss from the continuing injuries to the Illinois River system and Tenkiller Lake. As explained below, the estimated value is a lower bound on the average WTP per household in the study area to avoid a portion of the future injuries from excess phosphorus in the Illinois River system and Tenkiller Lake.

As described in Chapter 2, the survey presented respondents with a tradeoff: they could vote to pay an additional one-time tax for a program to accelerate the recovery of the Illinois River system and Tenkiller Lake back to what they were like in 1960 in terms of the clarity of the water, the amount of algae, the species living in the water and the amount of oxygen for fish. Or, they could vote "against" the program, in which case their household would *not* have to pay an additional one-time tax, and the river and lake would return *more slowly* to what they were like in 1960. Respondents were told that under the accelerated program, the river would recover in about 10 years instead of about 50 years, and the lake would recover in about 20 years instead of about 60 years. Therefore, the survey measured the respondents' WTP for accelerating the recovery of the river and lake from the injuries caused by phosphorus and algae by 40 years, so that the river system and lake would be returned to conditions similar to those in 1960 in 2018 rather than 2058 (for the river) and 2028 rather than 2068 (for the lake).

The survey used the close-ended valuation response format to determine each respondent's WTP for accelerated recovery. The additional tax amounts presented were randomly varied across respondents and were $10, $45, $80, $125, $205, and $405. If a respondent accepted the tradeoff associated with the additional tax amount presented, this implies that their WTP for the program was greater than or equal to the additional tax amount, but *not* less than that amount. Rejection of the tradeoff implies that their WTP was less than the proposed amount. Each response provides either a lower bound or an upper bound on the individual's WTP value to avoid the future injuries caused by excess phosphorus in the Illinois River system and Tenkiller Lake.

In analyzing such responses, economists assume that different people will have different WTP values for the item being evaluated. The differences in value may depend partly on variables that can be measured and that characterize the respondent, including the person's experience with the item, their income, and whether the person is an environmentalist. The differences may also reflect a variation in tastes, which goes beyond measured variables. For example, people with similar observed characteristics can feel differently about the same item. Economists view this latter type of variation as probabilistic. The result is a probability distribution of WTP values

across individuals in a population. The pattern of survey responses sheds light on the shape of this probability distribution. If, for example, 20% of the respondents voted "for" the program at a particular dollar amount, it can be inferred that, for 20% of the sample, their WTP value was greater than or equal to that amount. In statistical terminology, the proportions of "for" responses to the various dollar amounts reveal the *cumulative distribution* for the probability distribution of WTP values.

Estimating a cumulative distribution from proportions of binary (i.e., "for" or "against") responses to a stimulus variable – in this case the monetary payment amount – is a well-established problem in statistics.[1] Two statistical methods, parametric and non-parametric, are commonly used to estimate cumulative distributions. With parametric estimation, the researcher postulates a specific mathematical form for the probability distribution, such as the normal or the logistic distribution. Parametric estimation simplifies the problem to one of estimating only the parameters of the specified distribution, e.g., the mean and the variance. The numerical value of the parameters is determined by an estimation procedure such as the maximum likelihood method. Non-parametric estimation is a more general approach that avoids specifying a mathematical form for the probability distribution; instead, the form of the distribution and its parameters are both estimated. Non-parametric estimation, therefore, places minimal assumptions on the probability distribution. The only restriction on the estimation is that a cumulative distribution function is monotone; in our context, this implies that the probability of voting "for" should not increase with an increase in the dollar amount presented. In practice, with finite data sets, this restriction is often not satisfied empirically. Therefore it is often necessary to impose this restriction on the estimation. With a parametric approach, the restriction is imposed automatically. A maximum likelihood technique for imposing restrictions to non-parametric estimations was developed by Ayer et al. (1955) and is known as the ABERS estimator (Morgan, 1992; Robertson et al., 1988). The ABERS technique was applied to our data and the resulting estimate of the proportion of votes for the program is shown in Figure 7.1 and Table 7.1.

The non-parametric ABERS estimate is an estimate of the WTP distribution at the dollar amounts used in the survey. Once the distribution is known, a central tendency of the mean – the average of the WTP distribution – is determined and applied across the population. Statistically, the mean of the distribution is the area *under* the graph obtained by connecting the points in Figure 7.1.

1. Typical early applications were to data from dose-response experiments in medicine and related fields. The stimulus was the dosage of a poison (or, conversely, the level of treatment) and the response was whether or not the animal succumbed to the poison, or the person responded to the treatment.

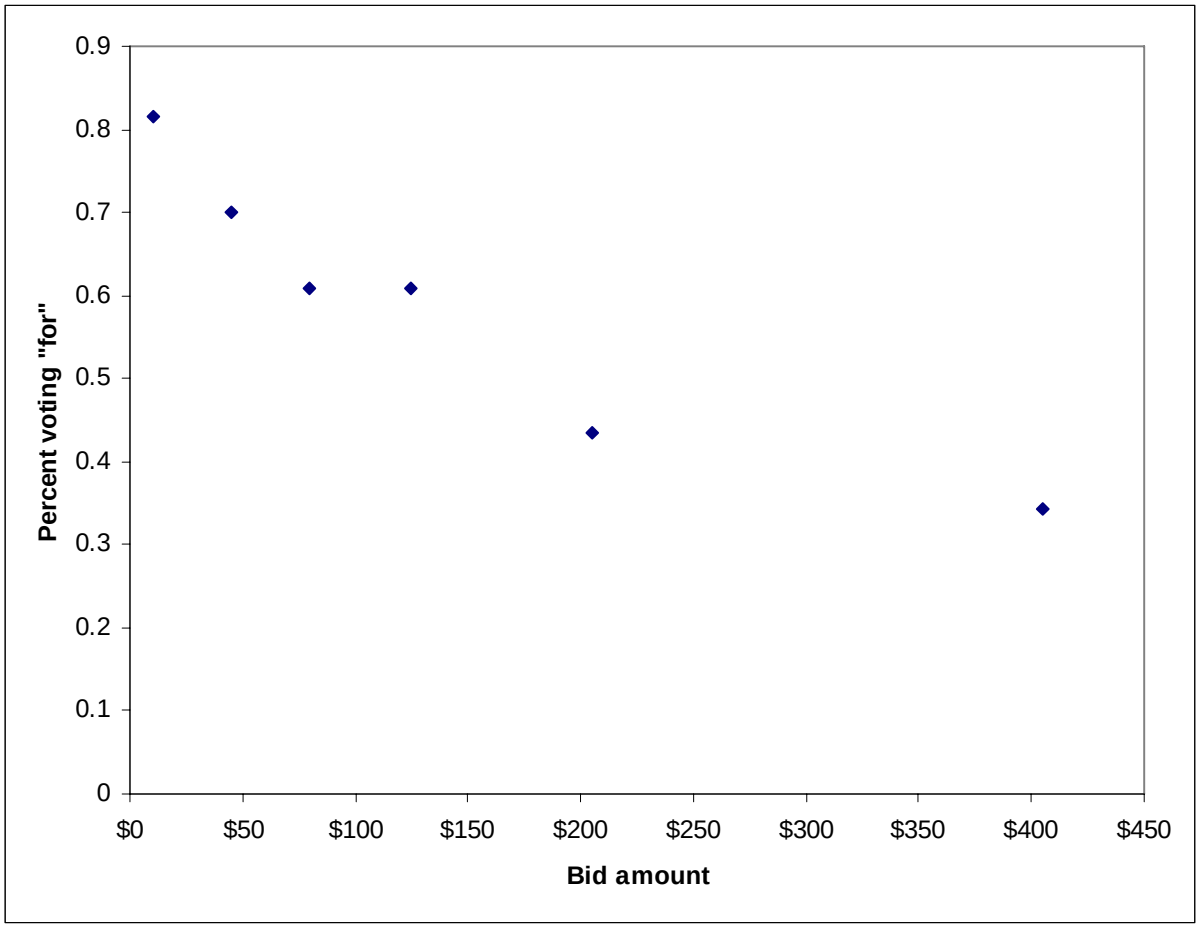

Figure 7.1. ABERS estimate of response proportions.

Table 7.1. ABERS estimate of response proportions

Vote	Mean	Linearized standard error	95% confidence interval	
$10	81.5%	2.9%	75.7%	87.2%
$45	70.1%	3.8%	62.5%	77.8%
$80	60.9%	3.2%	54.5%	67.2%
$125	60.9%	3.2%	54.5%	67.2%
$205	43.5%	4.3%	35.0%	52.1%
$405	34.2%	3.8%	26.6%	41.7%

There are several ways to connect the points of a graph of results, and each method provides a different estimate of the mean. One method, known as the Spearman-Barber estimator, involves drawing a straight line between pairs of adjacent points (e.g., Morgan, 1992; Hanemann and Kanninen, 1999). Another method (perhaps first introduced by Kaplan and Meier 1958) connects the points in the manner shown in Figure 7.2. This method provided an estimate of what, in their context, was the mean of a lifetime distribution (corresponding to the WTP distribution in our context) and s approximated by the area under the graph. The authors proved that the estimated mean converges to the true mean of the distribution *from below*, meaning that the estimated mean underestimates the true mean in finite data sets. Approximating the area under the graph as shown in Figure 7.2 was first proposed for use as a lower bound estimate of the mean WTP in a contingent valuation context by Carson et al. (1994, 1997). The method is now well recognized and accepted in the CV literature.

The area under the graph in Figure 7.2 underestimates the mean of the WTP distribution in several ways. Between adjacent points in the main body of the graph, say between the $45 and $80 points, it conservatively assumes that nobody in the population has a WTP value lying between $45 and $80. Thus, it assumes that anybody voting "against" at $80 could not possible vote "for" to any amount higher than $45. On the left end of the graph, it assumes that anybody voting "against" at $10 could not possibly vote "for" any positive dollar amount at all. On the right end of the graph, it assumes that nobody could possibly vote "for" any amount greater than $405. These are conservative assumptions, and they produce an underestimate of the likely mean of the WTP distribution.

For the data shown in Figure 7.2, the lower-bound estimate of the mean WTP is $184.55 per household in the study area, with a 95% confidence interval of $165.72 – 203.38.[2] As previously noted, this is a conservative estimate. First, for the statistical reasons just mentioned, it is an underestimate of the true mean WTP. Second, the item that the respondents were asked to value in the survey is a *truncated* portion of the *future* injuries from phosphorus and algae in the Illinois River and Tenkiller Lake. The survey did not account for damages occurring between now (2009) and 2018 (for the river) or 2028 (for the lake). Third, the assertion that, with a ban on the future spreading of litter but without an accelerated recovery program, the river and lake would recover in 2058 and 2068, respectively, may be optimistic. Scientific reports by Engel (2008a, 2008b, 2008c) and Wells et al. (2008a, 2008b) suggest the injuries would continue for some time *beyond* those dates.

2. The ABERS estimate of WTP for the scope program is $138.51 with a 95% confidence interval of $114.50 to $162.51.

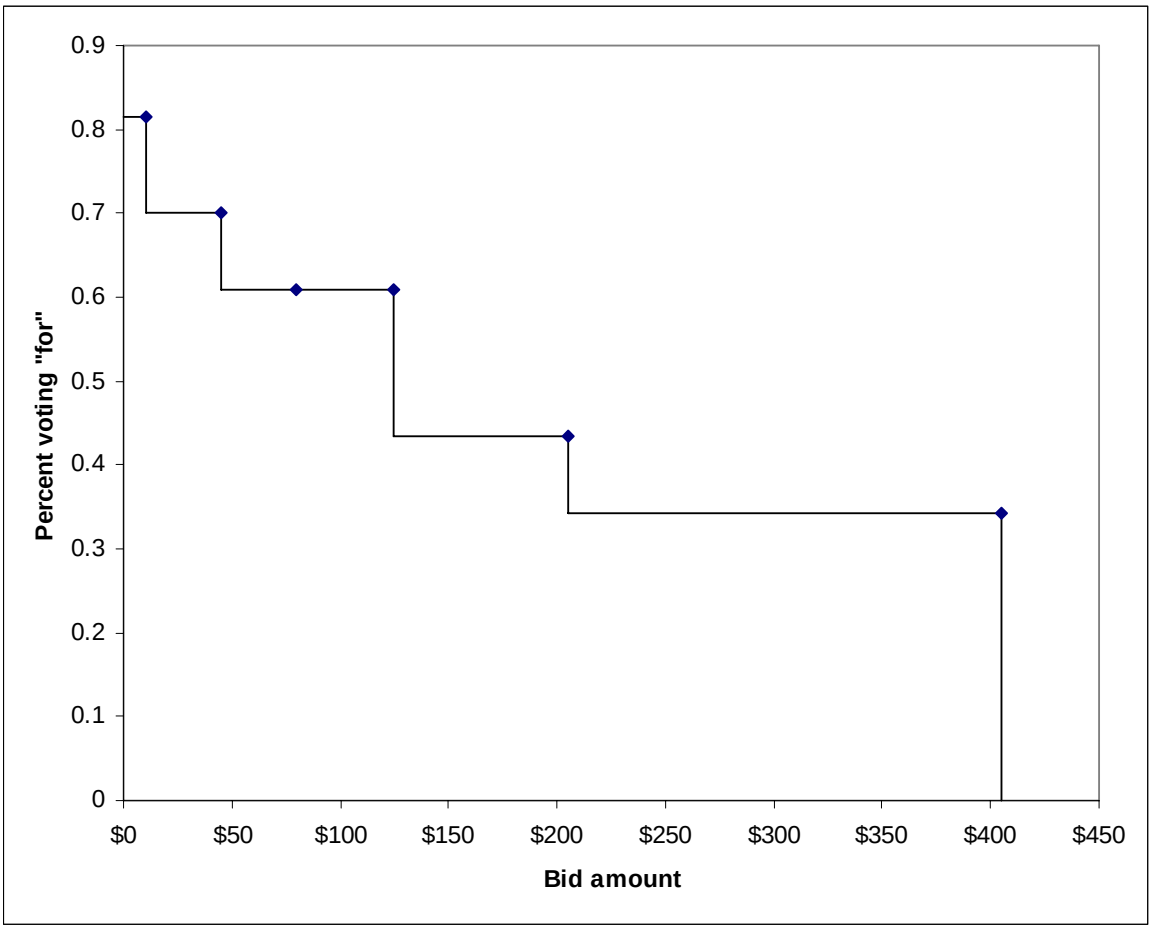

Figure 7.2. Lower-bound estimate of response probabilities.

In addition, the estimated mean WTP developed using data from this survey does not account for damages that occurred between 1981 and 2008. Furthermore, it does not include either injuries to surface drinking water or groundwater, or injuries associated with bacteria.

7.2 Aggregating the Estimate of Household Damages to the Public of the State of Oklahoma

As stated above, a conservative estimate of the average WTP value placed by a household in the study area on the injuries resulting from continuing pollution of the Illinois River system and Tenkiller Lake is $184.55 per household. There are 1,352,878 households in our study area (the 63 counties in the sampling plan).[3] Accordingly, a conservative estimate of the total value placed on these injuries by the public of Oklahoma in these counties is $249,673,635 (1,352,878 multiplied by $184.55). The 95% confidence interval for the aggregate estimate is $224,198,942 to $275,148,328.

3. This figure is based on the most recent estimates available from the American Community Survey (ACS), which are for the year 2007. The relevant data are available through American Factfinder (http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program = ACS&_submenuId = &_lang = en&_ts=), the Census Bureau's on-line program for disseminating ACS and other data. The Census Bureau does not publish ACS estimates for areas or subgroups with fewer than 20,000 people. Thus, the figure of 1,352,878 households is the ACS estimate of the number of households in the state of Oklahoma, adjusted downward to compensate for the exclusion of the 14 western counties from the sample. Census figures indicate that these counties include 3.4% of the housing *units* in the state; the adjustment assumed that the excluded counties included the same proportion of households (or *occupied* housing units).

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The primary authors of this report are:

Richard C. Bishop, PhD
Professor Emeritus, Department of
Agricultural and Applied Economics,
University of Wisconsin – Madison
2112 Regent Street
Madison, WI 53726

David Chapman, MS
Principal, Stratus Consulting Inc.
1881 9th Street, Suite 201
Boulder, CO 80302

W. Michael Hanemann, PhD
Chancellor's Professor, Department of
Agricultural and Resource Economics,
University of California, Berkeley
209 Gravatt Drive
Berkeley, CA 94705

Barbara J. Kanninen, PhD
4946 Rock Spring Road
Arlington, VA 22207

Jon A. Krosnick, PhD
Frederic O. Glover Professor in Humanities
and Social Sciences, Stanford University
Room 434 McClatchy Hall
430 Sierra Mall
Stanford, CA 94305

Edward R. Morey, PhD
Professor, Department of Economics,
University of Colorado, Boulder
440 Oakwood Place
Boulder, CO 80304

Roger Tourangeau, PhD
Research Professor, Institute for Social Research,
University of Michigan; and Research Professor,
Joint Program in Survey Methodology
University of Maryland
1218 LeFrak Hall
College Park, MD 20742

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University of Colorado, Boulder
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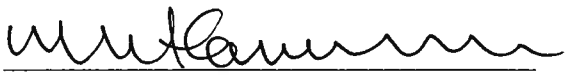

W. Michael Hanemann, PhD
Chancellor's Professor, Department of
Agricultural and Resource Economics,
University of California, Berkeley
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University of California, Berkeley
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and Social Sciences, Stanford University
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Chancellor's Professor, Department of
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Berkeley, CA 94705

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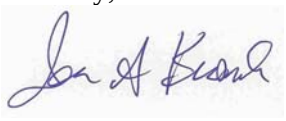
Arlington, VA 22207



Jon A. Krosnick, PhD
Frederic O. Glover Professor in Humanities
and Social Sciences, Stanford University
Room 434 McClatchy Hall
430 Sierra Mall
Stanford, CA 94305

Edward R. Morey, PhD
Professor, Department of Economics,
University of Colorado, Boulder
440 Oakwood Place
Boulder, CO 80304

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Research Professor, Institute for Social Research,
University of Michigan; and Research Professor,
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Professor Emeritus, Department of
Agricultural and Applied Economics,
University of Wisconsin – Madison
2112 Regent Street
Madison, WI 53726

David Chapman, MS
Principal, Stratus Consulting Inc.
1881 9th Street, Suite 201
Boulder, CO 80302

W. Michael Hanemann, PhD
Chancellor's Professor, Department of
Agricultural and Resource Economics,
University of California, Berkeley
209 Gravatt Drive
Berkeley, CA 94705

Barbara J. Kanninen, PhD
4946 Rock Spring Road
Arlington, VA 22207

Jon A. Krosnick, PhD
Frederic O. Glover Professor in Humanities
and Social Sciences, Stanford University
Room 434 McClatchy Hall
430 Sierra Mall
Stanford, CA 94305

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Professor, Department of Economics,
University of Colorado, Boulder
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Research Professor, Institute for Social Research,
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David Chapman, MS
Principal, Stratus Consulting Inc.
1881 9th Street, Suite 201
Boulder, CO 80302

W. Michael Hanemann, PhD
Chancellor's Professor, Department of
Agricultural and Resource Economics,
University of California, Berkeley
209 Gravatt Drive
Berkeley, CA 94705

Barbara J. Kanninen, PhD
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Frederic O. Glover Professor in Humanities
and Social Sciences, Stanford University
Room 434 McClatchy Hall
430 Sierra Mall
Stanford, CA 94305

Edward R. Morey, PhD
Professor, Department of Economics,
University of Colorado, Boulder
440 Oakwood Place
Boulder, CO 80304

Roger Tourangeau, PhD
Research Professor, Institute for Social Research,
University of Michigan; and Research Professor,
Joint Program in Survey Methodology
University of Maryland
1218 LeFrak Hall
College Park, MD 20742

STRATUS CONSULTING

1881 Ninth Street, Suite 201 Boulder, Colorado 80302 phone 303.381.8000 fax 303.381.8200 (headquarters)

1920 L Street, N.W., Suite 420 Washington, D.C. 20036 phone 202.466.3731 fax 202.466.3732

www.stratusconsulting.com